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The Soundtrack in Nontheatrical Motion Pictures

By FRANK LEWIN

The functions of the three components of the soundtrack — voice, music, sound effects — are delineated in Part I. In Part II the editing of the components is considered in detail. Preparation of the work print and sound tracks for re-recording is described in Part III. The re-recording (mix) is discussed in Part IV.

Parts II, III and IV will appear in subsequent, though not necessarily consecutive, issues of the Journal. *Publication of this paper as a booklet will be completed soon.*

Note: The term "soundtrack" refers either to the sound of a motion picture in general, or to the mixed track physically reproduced on the print. The term "sound track" refers to the individual track (*Voice, Music* or *Effects Track*) as described in editing and re-recording procedures.

PART I – COMPONENTS OF THE SOUNDTRACK

THE SOUNDTRACK of most nontheatrical films contains a mixture of voice and music, and frequently sound effects as well. The voice is either a narration, recorded after the film has been edited, or a synchronized dialogue, generally recorded at the time the film is shot. The music may be performed by any combination of instruments, varying from a single instrument to a full symphony orchestra; the score may be written especially for the film or it may be a composite of numbers gathered from a music library. The sound effects may be recorded synchronously at the time the picture is shot; more commonly they are added after the film is edited.

Voice (Narration)

With the exception of "sync" scenes, the soundtrack of a nontheatrical film is constructed entirely after the film is edited. With three elements vying for attention some ground rules should be observed to convey an intelligible message. The element that conveys specific information is the voice. The other elements of the track must work around the voice or so combine with it when they sound simultaneously that they do not distract attention from the words.

Although the voice must be given precedence over the other two elements, this does not mean that it should run with little or no interruption throughout the film. Like the other elements of the track its effectiveness depends on pacing and moderation — a steady unrelieved flow of narration frequently has a decidedly soporific effect which can seriously impair the narrator's function of gaining and holding attention.

A script that reads well, is grammatically sound and abounds in adjectives is not necessarily effective when heard against a visual image. Where the narration is called upon to do more than impart information, i.e. create a mood, heighten the impact of a picture and make it come alive, it is generally at a disadvantage compared to music or effects. Music and effects may profitably be made to take the place of adjectives, repetitions for the sake of emphasis or other rhetorical devices. It must not be overlooked that a chord of music can in an instant elicit a response which it would take a narrator quite a while to establish with great care and deliberation. In a soundtrack whichever element does the job at hand most quickly should naturally be given top billing, if for no other reason than that the running time of a film is generally limited and every additional foot of film often represents an added strain on the budget.

Edited Voice Track vs. Live Mix

The exact position of the voice vis-à-vis the image should never be left to chance. From among the many positions in which a sentence may find itself when sounding against a picture, there is generally one position which most precisely

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Edit. Note: Publication of this tutorial paper is a result of the Society's policy to present from time to time pertinent subject matter which is not otherwise currently available.

conveys the information to the viewer, placing the emphasis in that particular spot where it does most to explain and amplify the image. For this reason, it is advisable to record the narration and edit it to the picture, rather than have a narrator read the script at the time the film is re-recorded.

Further advantages of recording and editing the voice to the picture are:

(1) Fluffs are easily corrected by splicing in a pickup — at the time of the mix a fluff means an additional runthrough: wasted time for which re-recording studio rates are being charged.

(2) Changes are inevitable when a script narrated professionally is heard for the first time in its proper position against the film: sentences may have to be pruned or expanded; the cumulative effect of a narration running in sequence throughout an entire reel is quite different from that obtained by reading the script against the picture on the Moviola or projector; information which seemed explicit on paper may be found to be wanting in punch or clarity when heard against the film. It is not uncommon, and frequently advisable, to make adjustments in the picture when it is found that by doing so the narration is helped in making an important point.

(3) A tremendous advantage of a narration recorded beforehand and synchronized with the picture versus the quasi-impromptu approach of a live mix may be found in the greater ease with which music and effects can thus be made to work harmoniously with the voice. When the sound editor knows where music and effects are free to make their points without interfering with the voice he is able to save their punches for these open spaces, rather than sprinkle them throughout the film only to hear an overriding narration track render them ineffectual.

(4) By providing the mixer with a voice track whose problems he can assay and control much time is saved at the mix — time which can be used profitably to concentrate on aesthetic considerations.

(5) By recording a voice before the final mix, preferably wild rather than against picture, the director and narrator can concentrate fully on obtaining desired inflections and emphases. It is possible to record alternate versions and experiment in the comparative quiet of the editing room as to the most effective way of presenting an idea vocally in conjunction with the image.

The narration recording should be approached with a precise concept as to timing, character, emphasis and pace. As many of these fine points cannot be easily pinned down except through experimentation, it will be useful to do this experimenting on a test track. A scratch track (not necessarily narrated by a professional narrator) can be made inexpensively — for technical quality is not the aim — and this track can be edited and re-edited. It will clearly indicate whether the delivery accurately conveys not only the information but the desired impression. The final narration will benefit from whatever errors or miscalculations have become apparent in the scratch track; by knowing exactly what delivery to call for from his narrator the director can save time and expense at the recording session, and the editor can then lay in his track with a minimum of handling and re-editing. It is definitely inadvisable to play a scratch track for the client, unless he is very knowledgeable in the ways of films and can compensate for technical shortcomings at this stage of the production.

Music

Library music is used more frequently than a score composed and recorded specifically for the film. The reasons are several: (a) stock music is less expensive; (b) it is faster to select pieces of music already recorded and edit them than it is to compose and record a score; (c) library music has generally been recorded by a larger orchestra than would be economically feasible for the budget of a nontheatrical film (an argument that equates size with quality — two entirely unrelated and frequently antithetical concepts); and (d) library music may easily be tested by running it synchronously with the picture.

The fact that stock pieces of music are used repeatedly for different films makes a valid case for the use of an original score: the music is then unique. This argument is rarely a compelling reason. For one thing, what is asked of music is principally that it do its job tastefully and efficiently however that is accomplished; for another, the ability of a viewer to identify the music he hears with a film is vastly overrated by those in the trade.

Of much greater importance is the fact that library music, however carefully selected and skillfully edited, can never equal (although it often approaches) the flexibility and power of a truly "original" score. The originality need not thrust itself on the listener's attention by merely trying to sound "different." Rather that score may be termed genuinely original which seizes upon the musical possibilities inherent in the subject matter of the film and so realizes this potential that it unfolds in perfect harmony with the voice (and effects). By having complete control over his medium — as to ideas and execution — a skilled film composer can give his score a unity which library music, being of necessity eclectic, can rarely approach.

Function of Music

Whatever its source — where should music be used in a film, what character should it have, and what does it really do?

The use of music with voice raises the narrated film above the level of an illustrated lecture. When no sound effects accompany a scene which shows objects that in natural life make certain sounds, the music may create an illusion of activity which a silent picture lacks. Music, however, does more than simulate or imitate. By its very nature it is eloquent; often its appeal is emotional. This aspect of its character should never be disregarded.

Primarily the music must "fit" — it should re-enforce or harmonize with the impression the picture attempts to convey. Technical considerations should always be subordinate to this principle. A piece of music may faithfully accompany cuts, changes of scene, even to the extent of mickey-mousing actions on the screen; all this goes for nothing, however, if its character runs counter to what the picture tries to say. This consideration should apply even to library music where a choice between two pieces is likely to be made on the basis of recorded quality: unless the defects of the track are extremely disturbing it is preferable to employ the music that "fits" rather than a selection which, though technically superior, does not do what it is supposed to do. In deciding which music fits best, the question of taste arises — no rules can be given for that, of course.

It is relatively easy to judge whether music is suitable for a scene where it plays in the clear. When, however, it has to do its work in conjunction with a voice track other considerations must be observed. The meaning of the narration then becomes paramount, sometimes to the exclusion of the picture. Often the voice will utilize the image as illustrations to an abstract idea, or the picture acts as no more than a springboard for the script. If, for example, the screen shows scenes of animated industrial activity while the narrator talks in broad terms of the history of the company, it would be irritating to hear music which only suggests the bustling men and machines. Rather, the music should provide a dignified background for the words. Music should not say one thing while the voice tries to say another.

Speaking from a technical point of view, it is unwise to expect a piece of music that is strong and expressive when played alone to create the same effect when sounding under narration. The stronger the music, either in orchestration or volume of sound, the more it has to be subdued in order not to interfere with the intelligibility of the voice. It is, thus, often preferable to choose a selection which creates its effect

by relatively less intense means. It can then be played at a higher sound level without interfering with the voice and can be heard (and felt) more clearly. In writing an original score these technical considerations should be taken into account at the time of composition and the musical effects so planned — through judicious orchestration, for example — that they follow the voice faithfully. In the case of library music similar results can be obtained by the liberal intercutting of selections.

Vocal Music

When vocal music is part of the musical score especial care must be taken so that the sung words do not interfere with the words spoken by the narrator. It is obviously impossible to listen to two sets of words for any length of time and hope to make them both intelligible to the listener. It follows then that as soon as singing passes under narration and becomes a background it has to be kept quite low. Singing is, however, particularly unfitted to act as a backdrop to narration — it involuntarily attracts attention; when held so low under narration that it can do no harm it really ceases to be of much expressive value and approaches the border of being a sound effect.

Frequently vocal music will be interspersed with instrumental preludes, interludes and bridges. In choral music, humming and vocalizing sometimes relieve straight singing. It is extremely effective to confine the singing to open spaces between sections of narration and utilize instrumental, hummed or vocalized portions of the music as backgrounds to the narrator. When imaginatively executed this alternation of speaking voice with singing voice (solo or choral) makes for a wonderfully effective soundtrack.

As soon as the consideration of the intelligibility of the sung word ceases to be of importance, vocal music may in some cases be used freely as background to spoken narration. An instance of this practice may be found when the singing or chanting is in an alien language which few from among the prospective audience of the film are likely to understand; through lack of identifiable associations music recorded in locations remote in space and culture will often assume the character of a sound effect. This consideration applies to instrumental as well as vocal music. Unless the music itself is the subject under discussion in a particular scene it may be treated as a sound effect. These musical sounds cannot be expected to do the job that film music generally tries to do; what these sounds do accomplish is to convey an impression of the scene — a very accurate impression, assuming that the demands of authenticity have been satisfied.

Music in a film need by no means be continuous. If the voice says what it has to say clearly and fluently, and no other element of the soundtrack would appreciably contribute to the impression desired, it is best to leave the background silent. When music does enter it should do so at a strategic point in the picture, such as a transition, a sudden action or a pause in the narration. With its first impact the music says something definite. It is just as well to let this something be meaningful and have it contribute to the pacing of the film. Even when music is used in an entirely subordinate role it should always be considered as an expressive medium rather than a carpet of background sound. Musical changes and accents which are planned to work with the picture, or are used to emphasize points of the narration, are most satisfying — even to the viewer who knows nothing and cares little about the technical considerations involved - - when they are organic in the music rather than patched together or artificially created through boosting the volume. A piece of music ought, for example, to start at the beginning of a phrase or at a strong accent; it should not be faded ("sneaked") in. The same goes for exit points. It is not always possible to observe these niceties, and frequently the difference between a logical and an indifferent treatment of the music will be quite slight. To the argument that "it makes no difference," however, the answer can be given that a carefully treated soundtrack *will* make a difference in the impression created by the finished product, even if the details that have gone into creating this impression are not readily discernible to the naked ear.

Interaction of Voice and Music

In a soundtrack where the two elements of voice and music are present, many instances will occur where it is possible to choose which of the two should do a specific job. Emphasis to heighten the impact of a startling cut, for instance, may be obtained by placing the narration so that it hits with the cut. It is best not to entrust the music (or an effect) with the same job at the exact same moment. A stronger impact can be achieved in the above instance by letting the music hit on the cut and placing the voice so that it enters about 12 frames later. The impression to the viewer will actually be simultaneous. The same considerations hold true in the case of sound effects combined with music and/or voice.

But a simultaneous impact may not be the most effective way of treating such a change of scene. Any scene which should register as a decided change from the one preceding it is more effectively introduced by delaying any explanatory narration until a strong musical or sound effects statement has established the change firmly. (This is especially true when the previous scene contained a great deal of narration as it ended.) The new scene will actually rouse the viewer's interest more effectively if he is left guessing for a short while until the voice picks up again. This treatment must, of course, be handled so that it does not split thoughts which should remain intact to preserve their sense.

When narration is split apart to allow other elements of the track to come to the fore, careful attention must be given not to start a sentence with a dangling conjunctive which originally joined it to its predecessor. "But," "likewise," "however," "whereas" — when they occur in a spoken text — are much more at home in radio scripts and speeches than in a motion-picture script. In their more accustomed media they form the mortar that cements sentences and paragraphs into a smooth whole. In the soundtrack of a film, this function is performed by music and effects — they efficiently supply continuity to even the sparsest and most sporadic narration.

Music Under Lip Sync

In nontheatrical films it is rarely effective to use music under lip sync. Music in such a situation will always tend to make the scene seem unreal. Unless this impression is intended, or the music is of a character which will suggest that it originates from somewhere in the locale in which the speaker on screen is situated (radio, band, possibly a neighbor practicing on an instrument) it is best not to add a confusing element at this stage. Once the voice, however, becomes dissociated from the image and evolves into what, in effect, is a narration the music can be treated as under any other voice-over narration. In cases where the film shifts back and forth between lip sync and voice over, this rule need not be rigidly followed. Depending on the proportion of sync and voice over, it may be wise to stick to a consistent pattern: when there is a preponderance of lip sync and the cut-aways are of brief duration, leave the music out; otherwise use it. Where it is possible to use sound effects during the cut-aways it will be even less necessary to supply these scenes with music.

Cuing Music to Voice

It cannot be emphasized too strongly that the success of the musical score for a film depends to a great degree on the felicity with which it works with the voice and sound effects. It is indispensable for the music editor to have an exact log of the voice. Whenever practicable the music editor should prepare this log himself; in a film where interaction of voice and music is greatly detailed this count must be accurate to the frame. When taking voice cues it may be found useful to write down the last words of the sentence with which a

section of narration ends: they will help to avoid the necessity of having to refer back to the script or refresh the memory by running down the narration track once the actual editing of the music gets under way. These verbal cues are of value to the re-recording engineer as well — in conjunction with the footages on his cue sheet they give him an accurate audible guide of the point at which to raise the level of music or effects.

It is of great importance to note to the exact frame the end of a section of voice which is to be followed by a strong musical change or accent. The editor can then lay in his music with the certainty that when it is preset at the mix it will hit clean without stepping on the tail of the outgoing narration. An efficient way to find this point is to follow mentally the rhythm of the voice as the track runs down on the editing machine (Moviola) — then brake the machine or tap the voice track with a grease pencil at the point at which the narrator would have spoken the next sentence had there been one. In this way the rhythm of the voice dictates the entrance of the musical cue: in the case of a rapid delivery the music will start almost immediately after the last word is spoken; where the delivery is leisurely the music will enter after a slight pause — in any event the music thus carries forward the momentum of the narration and enters in a way which seems natural to the overall pace.

The surest way of securing perfect interaction of different elements of the soundtrack is through the use of a multiple-head Moviola. It is almost indispensable for editing a track in which music and voice alternate back and forth rapidly.

Cuing Music to Picture as Well as Voice

Frequently activity in the picture dictates the entrance of the music. Whenever possible, the score's relation to the narration must still be observed, and it may often help to move the narration slightly to accomplish a clean and effective entrance of the music. An example: the music (or a startling sound effect) is to enter on a cut; a sentence of narration concludes immediately before the cut — so close in fact that the sound which is now supposed to enter with the cut would trip uncomfortably on the heels of the last word. In such a situation something must give: either the narration should be moved back a few frames or, if that is not possible, the scene should be extended slightly. The reverse situation will often face the sound editor: the narration ends well before a cut and the music must either tread water until it can come into its own or anticipate the cut. So common is this situation, actually, that it is a sure sign of an ill-planned soundtrack. The solution here is either to move the voice down to the cut, or to move it back sufficiently so that the resultant pause becomes long enough to be meaningful: the music may then be brought up and change decisively on the cut.

It will repay the sound editor, especially if he has control over the placing of the narration, to check his entire voice track with an ear towards the music and sound effects which will have to work in conjunction with the voice. In any fairly extended film (eight minutes or longer) *some* attention must be given to the pacing of the voice track. Even a track that has so much to say that it seemingly fills the entire running time of the film can often be paced more interestingly by pulling together sentences, and sometimes phrases, which are delivered with unnecessary deliberation. Pauses two to three seconds long abound in most narration tracks; they are generally not long enough so that the reason of "letting the thought sink in" may be adduced and they are certainly too brief to bring up music effectively. By eliminating a few of these "holes" in a sequence — if that can be done without impairing intelligibility — a block of continuous footage free from narration is thus accumulated. Placed at the beginning of a sequence, somewhere in the middle where a breather would be welcome, or at the end this space affords the music (or sound effects if they are interesting in their own right) a chance to take over. When the voice enters again after, say, a 12-second hiatus it commands attention. The process may be compared to driving on a generally straight highway: one sharp turn in the course of a section of road whets the driver's attention more effectively than a few shallow curves spaced apart.

Placing Voice for Maximum Effectiveness

Where the narration in the course of a film is sparse enough to let entire sections of voice be consolidated into blocks, the opportunities for creating an interesting soundtrack become more plentiful. It must always be kept in mind that music establishes a definite mood. The entrance of the voice acts as an interruption of that mood, however skillfully the two elements are fitted to each other — the more often a mood is established and broken again, the more dispersed the track's effectiveness. The culminating offense in this respect consists of building a sequence toward a climax, employing music and often sound effects as well: at the height of the excitement, or worse still just before the climax, the voice enters — all the carefully planned increase in level and intensity must be subdued, generally by mechanically dialing down the volume, so as not to interfere with the narration.

A similar effect, or rather lack of effect, occurs when a sentence in the course of a sequence is placed in such a position that it coincides with loud and active music and/or sound effects. It will often be found that a descriptive sentence can convey its information as readily when placed before or after the action on the screen to which it alludes. Let the music or sound effects give their all, synchronously with the picture — for they can not be shifted away from the image to which they belong — and let the voice be a commentator before or after the fact. It must always be remembered that music or effects can deliver a punch much more forcefully, and in a shorter space of time, than the voice. Of course, if one wants, for instance, to recreate the excitement and noise that go with a field of horses thundering down the homestretch and at the same time have the narrator deliver a whispered thought voice describing a jockey's innermost feelings, something has to suffer. That something is generally in the first place the budget: hours and hours of mixing time will not achieve a satisfactory result. The suffering of mixer and sound editor (and often the viewer who sees the finished product) may be more subtle but none the less real.

Another device for obtaining variety from the narration may be mentioned: the practice of changing from one voice to another in the course of the film. When the alternation coincides with changes in the picture this procedure sometimes works. When the change of voice is from male to female (or vice versa), or to a child's voice, the procedure will definitely create variety. When the differing voices become identified with objects or actions on the screen — cartoon style — or are used dramatically the practice is often successful. When, however, the alternation is performed with little provocation, in the hope that a change of any kind will rivet the viewer's attention, the result can be extremely disappointing. The danger exists that the listener will be thrown off the track (in more ways than one) by an unmotivated switch in narrator, and has to catch up. Clarity is likely to be sacrificed for the sake of a momentary effect — and the effect really is momentary, for unless the new voice employs a radically different style of delivery the change will soon have been forgotten. Variety in the soundtrack can be achieved so efficiently by alternating dissimilar elements — voice to music, voice to effects, music to effects, in many combinations — that it does not pay to lavish effort on trying to create it within this basically monochrome element of sound.

Deviation From "Industrial" Treatment

With increasing frequency, the elements of fantasy, whimsy, humor and drama find their way into nontheatrical films. Occasionally complete sections of the film will be treated as would a straight dramatic film: with scenes which depend for their unfolding on dramatic action rather than following the

logic of a narration. These deviations from the more common "industrial" style may be extensive or quite brief — at any rate, they should be encouraged for they are harbingers of the day when it will be generally recognized that these films can be entertaining at the same time that they inform or deliver a pitch. The music must, of course, suit its treatment to these changed conditions: it should be sharply in character with the action, loquacious where the burden of the soundtrack's action falls on it, reticent where it is little needed. Above all, a clearly different type of music must be employed from that used in conjunction with ordinary narration. It is better not to use any music in the course of a scene constructed and executed dramatically, carrying its own soundtrack recorded on the set, than have it plod on and get in the way. This warning is merely cited for those faint of heart who mistrust the power of communication that the dramatic treatment may impart to a film deviating otherwise but little from the norm, and call for music to "hypo" the action. The tenet that "a bit of music helps" is only valid where the music has something to contribute in its own right — it generally falls flat when it is used as a crutch.

Sound Effects

Sound effects used intelligently are a sure means toward creating variety, especially when they are employed in moderation. Theoretically, effects may be edited to supply sound for every scene of a film. In practice this rarely works out. A nontheatrical film is seldom shot or cut so that scenes develop as they would in a dramatic film: consecutively and with a logic dictated by the action. Rather, the picture is edited to follow a continuity dependent on the information the narrator has to get across. Many sounds are cumulative in their effect and depend on a certain duration in time to become meaningful (a car starting off, shifting gears; a train approaching, passing by, receding; a generator gradually warming up). The picture frequently cannot wait until the effect has become established — the object may be on the screen for a few feet only until the narrator moves on. Furthermore, intercutting between scenes may juxtapose in rapid succession images which demand fairly active and loud sounds with those calling for gentle or no sounds at all (interior of a factory to an aerial exterior view of the same plant, for example, and back again). In many instances the sound produced by the image may definitely work counter to the ideas or the feeling the narrator is trying to convey. Consequently, sound effects in a nontheatrical film must be selective.

What effects, then, should be included realistically, which should be omitted; which scenes should be treated unrealistically by the use of music rather than effects, which by musical effects simulating the sound of the image?

Choice of Treatment

The first consideration should be to include those sound effects to which specific reference is made in the narration. It is, of course, necessary that the effect *sound* technically correct. It does not follow, however, that the best effect for a scene is the one recorded on the spot. The ear, like the eye, is selective and will hear that sound to which attention is directed. In a scene showing a noisy factory in full operation the overall sound picked up at the scene may be so general and confused that it has no character at all beyond that of an all-encompassing roar. If this is the kind of sound the scene is to convey, well and good; it will rarely be interesting for more than a few moments after which it becomes a background of noise.

Sounds in a film, however, must be interesting as well as plausible — herein lies the secret of an effective sound treatment. Suppose the camera travels through the factory, scanning a variety of machines from different perspectives and distances. It may then be important to introduce in the soundtrack the noises of isolated machines, projecting out of the background of the overall sound. In actuality these machines could not possibly be heard individually in the factory but in conjunction with the picture the impression will be entirely believable, and as the sound changes in character and intensity the variety thus produced will keep the track alive. Should it be impossible to achieve variety because the sounds encountered in a scene are generally similar in character, a difference may have to be created artificially by changes in volume or equalization. Without changing basically the character of the sound it will then *seem* different and the object of variety is attained.

Imagination in Effects Treatment

Not all sounds need be technically accurate. Often what the viewer expects to hear in conjunction with the picture is far from what the scene delivers in real life. Imagination must then be exercised to make the sound larger than life, by changing its character or substituting a sound obtained from an entirely different source than would be indicated by the picture. Not all brooks, for example, burble on a quiet summer day; as a matter of fact they tend to be quite silent. At the time of day when the sun is brightest to get a good color shot the birds in this particular location may be undemonstrative. Yet it may be desirable to treat this scene with suggestive sounds — actuality should then be replaced by fantasy and the water must gurgle and the birds warble. The sound of the water itself will rarely be obtained by recording the brook: in order to get an interesting sound it will be advisable to find a likely substitute, such as the sound produced by dipping a stick sporadically into water; the birds can easily be located from stock effects. The power of association when viewing a film must constantly be called into play: if the effect *sounds* right it makes no difference at all where it came from originally (to suggest, for example, the power of a rocket blasting off from its pad the sound of an atomic explosion is frequently employed with no detriment to its believability). Authenticity is fine in the script, voice or music — with sound effects it is often a decided liability.

Another aspect of the divergence of film sound from real-life sound: actions that the eye sees on the screen often need to be provided with a sound effect even though in real life the sound would be swallowed up by louder surrounding noise. As an example: a herd of camels is being ridden, hooves thudding on the ground, riders yelling at the top of their voices. The camera shows a head-on shot of the action and clearly shows whips descending to spur the animals on. It is effective to make the snap of the whips audible; if omitted, the sound would be missed.

Assuming no reference to the sound is made in the narration, the editor can exercise his judgment as to which sounds he wants to make audible. An action obviously producing a sharp sound (explosion, shot, steam whistle being blown) should be heard. Actions producing distinctive sounds which continue for a certain length of time (hammering, hoof beats) will gain in effectiveness if accompanied by their appropriate sounds. It is, however, not essential to treat them so — music may create the illusion of hearing these sounds or express the feeling produced by them, and the editor can save himself a great deal of work if he knows that the film's score will actually do this job well. Sounds which are so general that in real life we are hardly aware of them (traffic, leaves rustling) had better not be treated realistically at all unless they form a background to more specific sounds or act as background to a fairly continuous narration; the impression produced may actually defeat the purpose for which it was intended: by making the listener conscious of the sound, attention will be focused on a relatively unimportant aspect of the scene.

Organizing Effects

When effects are the only sound heard on the track they must be carefully sorted out in the order of their importance. A sound never proceeds out of a vacuum — it is part of an overall background. It will not do, for example, to expect the sound of a car to carry a scene in which the automobile is

shown approaching from a great distance. Some sort of exterior presence (possibly light traffic) should establish the scene before the sound of the car becomes audible, increases in volume and recedes. If the car is still visible at a point where motor or tires could not possibly be heard anymore, the exterior sound will still keep the scene going.

The foregoing is, of course, only a very simple illustration of what is required to reconstruct a scene in sound. For the above scene it will rarely be sufficient to provide only the two sounds mentioned. A fairly quiet background will lack character; until the sound of the car becomes established some interest has to be maintained in the track, possibly through the discreet use of a distant car horn or other appropriate off-screen sounds. Care, however, must be exercised as to what kind of unestablished off-screen sounds are introduced into a scene. It is possible to *assume* almost any kind of sound taking place off screen, but is it also plausible in the particular situation? Does it introduce a feel into the scene which is at variance with the impression the picture tries to make? No hard and fast rules can be propounded to determine the appositeness of sounds not established by the image — this belongs in the realm of individual taste. It is best, as a rule, not to take too much for granted.

Interaction of Voice, Music and Sound Effects

In nontheatrical films extended scenes which depend on sound effects alone, with neither narration to explain nor music to enliven them, are rare. As soon as narration becomes part of the track the conditions discussed in the previous paragraph may to a certain extent be relaxed. Under narration the comparative monotony of a fairly uniform general background sound becomes an asset: such sound keeps the scene alive without interfering with the voice. As a matter of fact, in many scenes where ordinarily an extremely nondescript musical background might suggest itself — either because the voice is so constant that music with much character would have to be completely underplayed, or because music has basically nothing to contribute either to the image or to the message of the narrator — an appropriate overall sound effect makes an ideal means of filling the vacuum. The music, when it finally does appear, can enter with great effectiveness — it will represent a welcome change. The rule that specific effects should proceed out of a general background sound should, however, not be disregarded even if the whole sound effects track is subordinate to the narration. The "dead" feeling which surrounds an isolated sound effect is generally quite noticeable even under voice.

Isolated effects can, of course, be used without any background sound whatsoever where they occur while music is running. The music then takes the place of a background sound, albeit a very eloquent one. In such a situation it is good practice to treat specific sound effects as if they were part of the musical score. A sound effect which occurs at a strategic place in the music — in a breathing space between phrases, over a held chord, following or preceding a sharp musical sound such as a stinger chord — becomes an organic part of the soundtrack. A further advantage is, again, the application of the principle that no two elements of a soundtrack should make a sharp impression simultaneously. Not only are they likely to get in each other's way technically so that it is often difficult to establish the character of a sound effect that has to struggle against an active musical competitor, but they serve different functions in the overall scheme: the sound effect spells out reality; the music adds fantasy or commentary or emphasis and possibly all three combined. Where, for the sake of strong emphasis, a simultaneous impact is intended it is still advisable to stagger music and sound effect slightly: a shot pointed up with a stinger chord, for example, should precede the music by eight frames.

Relative Roles of Effects and Music

As a rule it is unwise to suggest in the music what the sound effect portrays realistically at the same time. An analogy from arranging for orchestra may serve as a parallel. It is one of the basic axioms of a well sounding piece of music that the instruments accompanying a tune should not be active in the same register as the instrument that carries the melody. Much can be done nowadays through skillful microphone technique to vitiate this principle, but the result will always tend to be more mechanical than natural. Applied to the soundtrack of a film this would work as follows: when both music and sound effects accompany, for example, scenes of a railroad train under way, the music should not try to simulate the sound of the train where the sound effect does the same thing. Rather, at the same time the sound effect projects the sharp click of the rails, the rumble of the cars and whine of the engine, the music might move in broad, sustained sounds — the combination of the two elements, complementing each other, would then convey not only the idea that this is a train in motion but, through the expressive force of the music, would suggest as well something of the power and impressiveness of the scene.

Where a sound effect lasts for a certain amount of time (a plane passing overhead, for instance) and is to be established clearly as the predominating element, it is often wise to let the music go out gracefully as the effect enters, possibly on a sustaining chord of neutral character which loses itself as the sound effect gains in volume. The effect will then actually seem to carry forward the momentum established by the music and when it has had its say should relinquish the center of attention as gracefully. Many sound effects actually approach the character of music, either because they are strongly rhythmic or have definite pitch (whistles, bells). It becomes that much more important in such instances to treat them as though they were part of the musical score.

In order to achieve the kind of soundtrack in which music and effects are well integrated it is important that sound effects and music editors work closely together or, ideally, that one man be editing both. The most elaborate interaction of music and sound effects must, however, at all times work harmoniously with the narration — this cannot be emphasized too strongly. Disregarding the voice leads to the danger of doing a lot of work for nothing. The narration claims undivided attention when it is on stage and anything going on at the same time, unless carefully coordinated, cannot possibly make itself heard clearly or become fully effective. Music editors and composers are generally charged with urging the mixer at a re-recording session to play their tracks loud, and sound effects editors are supposed to be equally fond of hearing their work shine forth. Whether that is so or not will, however, never detract from the fact that whoever edits the voice track will always have literally the last word. Consequently, the closer the cooperation of all sound editors, the better the final result and, incidentally, the less unnecessary work all around.

NOTE: Part I, published here, comprises about one-third of the total paper. Budgetary and scheduling commitments may not permit the subsequent Parts to appear before summer. The complete paper in booklet form will be available from Society Headquarters within a month.

A Continuous-Loop Magnetic-Tape Magazine and Its Applications

By LOUIS G. MACKENZIE

Design and operation of an endless-loop ¼-in. magnetic-tape magazine with uniform low-friction tape motion and a five-channel selective program repeater are described. Features include high-speed solenoid actuation for instantaneously cued stop-start operation, and transistorized audio and control circuitry. Applications are discussed.

THE FILM INDUSTRY uses endless loops in many applications. The most common use is of lengths of film strung over multiple sets of adjustable rollers so that a sound "dummy" can repetitively play out a continuous background type of sound effects for the track on the film loop.

While this method has been used successfully for many years, it has been an expensive operation because it requires the tying-up of an expensive "dummy" for each background effect used during any dubbing session. Also a sizable amount of rack space is needed to support the film or tape loop. Furthermore, these effects loops are not easily stored and do not lend themselves physically to setting up a library of sound effects.

During the past year, MacKenzie Electronics has developed and marketed a Five-Channel Selective Program Repeater, with a design based upon the use of a compact endless-loop, ¼-in. magnetic-tape magazine. This magazine is the result of a ten-year research and development program. The early magazines, while satisfactory for voice applications, did not move the endless-loop magnetic tape smooth'y enough to justify their use in professional applications.

Presented on October 24, 1958, at the Society's Convention at Detroit by Louis G. MacKenzie, MacKenzie Electronics Inc., 145 West Hazel St., Inglewood 3, Calif.
(This paper was received on September 29, 1958.)

Tape-Magazine Development

A major development in our tape-magazine research program occurred approximately one year ago, resulting in tape motion so uniform that immediate consideration was given to the use of these magazines in precision equipment.

Figure 1 is an upside-down view of our present magazine loaded with approximately 100 ft of ¼-in. tape. The spiral mass of tape is held centered in the magazine around four nylon rollers. The tape is pulled from the inside of the spiral, between the rollers, and out through a corner of the magazine. It then passes the tape transport outside the magazine and thence back into the magazine where it rewinds onto the outside of the spiral mass. In this view, the magazine's turntable and bottom cover are not shown.

An "exploded" view, Fig. 2, shows the magazine in right-side up position, as it is in actual use in the machine. Note that the spiral mass of tape rests on a turntable which is powered by the machine and it's action is such as to keep the tape winding continuously on the outside of the loop. This allows any "slack" in the tape to accumulate at the inside of the spiral where the lack of tension so produced permits the tape to be pulled out of the magazine with no undue friction.

An important factor affecting any endless-loop device of this type is that it operates with continuous friction between loop turns. This is because all portions of the tape are traveling at the same lineal velocity, but as any point on the tape moves toward the center of the loop, its angular velocity changes; therefore each turn must slip slightly inside the next adjacent turn. The accumulated effect of several hundred turns, each slipping slightly against the next adjacent turn, is to create a substantial amount of total frictional loss. This loss means that power is required to perform the endless operation. Conventional loop designs furnish this power by operating a tight loop mass and pulling the tape from the inside of the loop by force. Thus, the tape must transmit the power into the loop and it is not physically strong enough to do so for any extended period of time.

In our design, the turntable on which the mass of tape is supported is powered directly by the machine. When this turntable is driven at the correct speed, its radial velocity equals the lineal velocity of the tape on the inside of the spiral mass, and the outgoing tension on the tape is reduced to zero. It is interesting to note that by proper choice of speeds, this action can be made slightly regenerative and the tape will actually be pushed out through the magazine.

We have utilized this principle for some time. However, magnetic tape used in this manner reveals some characteristics that occasionally cause trouble. For example, if the turns do not readily slide against each other, there is a tendency for the tape to act as a solid mass and at this point the turntable tries to drive it past center, resulting in a binding action.

Figure 3 illustrates how this problem was resolved and shows a cross section

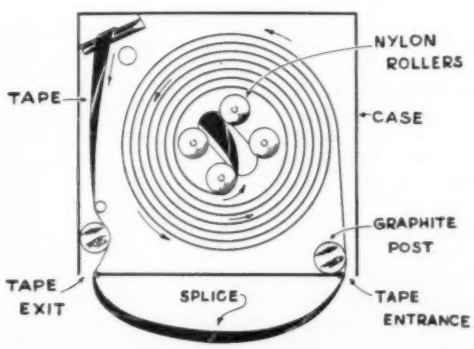

Fig. 1. Upside-down view of magazine loaded with approximately 100 ft of ¼-in. tape.

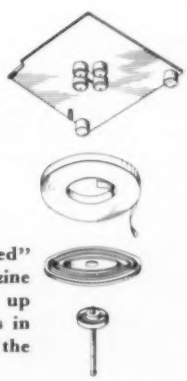

Fig. 2. "Exploded" view of magazine in right-side up position as it is in actual use in the machine.

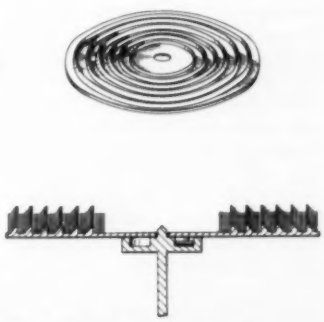

Fig. 3. Cross section of the turntable with the mass of tape resting on it.

Fig. 4. MacKenzie Model 5CPB Five-Channel Selective Program Repeater.

of the turntable with the mass of tape resting on it. It will be noted that the turntable is molded with a series of concentric rings of saw-tooth cross-sectional shape. Whenever an individual turn of tape gets inside one of the rings, it cannot back out. The mass of tape, therefore, is broken into a series of concentric masses each isolated from the others by the concentric saw-toothed rings. Consequently, we now have a large number of thin endless loops each operating independently from the others, and we find that the tape no longer has any tendency to operate as one large mass and that the tape motion is uniform and smooth.

Under conditions of low atmospheric humidity, the mass of tape acts as a very efficient static generator causing turns of tape to stick together and effectively stall the magazine. The two round posts inside the corner of the magazine in Fig. 2 are made of pure graphite. The tape passes over these posts continuously and a very thin coating of graphite is deposited on the tape. This provides a conductive path which effectively drains off any static charges and has the advantage of supplying a continual lubricant, thereby practically eliminating head wear.

For example, there are several hundred machines in continuous operation at Disneyland, most of which have been in use since July 1955. The initial heads are still operating and most of them have played out millions of feet. Some tape loops, incidentally, were played over a million times before they were replaced. The tape magazines will hold approximately 200 ft of tape. Magazines can be loaded with any desired total program length from 2 sec to over 5 min, at $7\frac{1}{2}$-in./sec tape speed.

Five-Channel Program Repeater

This new tape-magazine design permitted the development and production of our Model 5CPB Five-Channel Selective Program Repeater, illustrated in Fig. 4. This machine holds five tape magazines on hinged trays. Each tray incorporates the necessary pressure roller and magazine driving assembly so that it can be engaged by high-speed solenoid action with a rotating capstan which is common for all five channels. Five separate playback heads are connected to individual transistorized preamplifiers, each with low-impedance output terminals. The 5CPB is complete with power supply and individual solenoid connections brought out to terminals for remote actuation of any one channel or combinations of any of the five channels.

The most important feature of this machine is it's instantaneous stop-start operation which is achieved by engaging the tape loop with a continuously rotating capstan upon actuation by a high-speed solenoid. This system permits the instantaneous starting and stopping of individual tape loops. Tests show that a tape loop recorded with a steady tone can be started and stopped so rapidly that the human ear will not detect any transient.

To capitalize upon this high-speed operation, each of the five channels is equipped with small photoelectric cells which operate in conjunction with transistorized pulse amplifiers that control the individual solenoids. A cue mark consisting of a narrow stripe of silver paint is painted on the tape at the precise beginning of the program material. When the cue mark passes the photocell, the resulting light pulse triggers the solenoid, disengages the tape transport from the capstan, and the tape stops immediately. The tape is then ready to start again precisely "on cue" upon the push of a button. This feature, for the first time, allows the insertion of lip-synchronized audio effects into live productions without elaborate and time-consuming preparation, with the attendant danger of missed cues. Gun shots, music bridges, laugh tracks and any other special effects can be "cued" and played either individually or in any combinations. If cue marks are not put on the tape, continuous background effects such as crowd noises, thunder and lightning, footsteps, traffic noises, birds etc., are readily available.

Applications

The Five-Channel Selective Program Repeater was designed primarily for use by the radio-broadcasting, television, and film and sound-recording industries. However, it has proved to have many other specialized and industrial applications requiring the storage and precision playback of prerecorded program material. For example, Disneyland uses several hundred MacKenzie single-channel program repeaters along with a number of 5CPB Program Repeaters for playing the special effects used on the various rides and attractions. A recent requirement of a completely automatic paging system for airline and airport-terminal facilities resulted in the development of our Automatic Selective Pre-Recorded Announcing System which features the instantaneous playing of complete announcements or the synthesis of complete announcements from combinations of message segments which are selected by dialing or switching. This is possible with our multichannel program repeaters due to the instantaneous stop-start "on cue" playing of stored program material.

Model 5CPB Specifications

The Model 5CPB mounts in a standard 19-in. relay rack. It is $8\frac{3}{4}$-in. high and requires a 12-in. minimum clearance behind the front panel. The total weight including magazines is less than 40 lb. (It can be supplied in a portable case.)

The tape speed is $7\frac{1}{2}$ in./sec. and the audio performance is standard in all respects. The frequency response is within 5 db from 50 to 10,000 c and the signal-to-noise ratio is 55 db, or better, from standard tape level. Wow and flutter measure less than 0.25% total rms. The individual preamplifiers will deliver −20 dbm into a 600-ohm load, with plenty of reserve. The total power requirement is 60 w (slightly higher when equipped with a synchronous motor).

A Practical Projection Gaging Method for Visual Inspection of 16mm Release Prints

By MAXWELL A. KERR

A 16mm projector with a special aperture plate is used as a projection gage for checking various print characteristics while viewing the projected film. This method enables checking of such factors as soundtrack centering and modulation of variable-area tracks; shrinkage and variations in width of film stock; blackness and freedom from scratches of septums on each side of the soundtrack; placement and opacity of the printed frame around the picture image; and percentage jump-and-weave in the projected picture, including the amount added by printing operations.

In 1952 the author conducted an investigation in the relation between 16mm sound-film standards and current film laboratory practices and inspection procedures. This investigation was sponsored by the U.S. Navy, Bureau of Ships, Code 565. Some results of the investigation were presented at the SMPTE 1952 Fall Convention at Washington, D.C., in a paper which gave practical proposals for the gaging of various 16mm release print factors by the use of a special design of picture aperture plate plus some refinements in the setup and use of the associated projector. In that demonstration an aperture plate was used which was designed by the author for use on the Navy JAN-type projector. The plate was manufactured by the DeVry Corp., through the efforts of Ellis D'Arcy, at that time Chief Engineer for the company.

Figure 1 shows the dimensions of the original gaging aperture and types of release-print faults that can be detected through the use of the 1952 aperture design. Figure 2 is an outline of a simplified plate design.

The first step in designing the gage plate was to make a detailed study of ASA standards on film dimensions plus related printing and projection requirements. Based on the standards, a large-scale composite drawing was made; it was very useful in solving questions raised by tolerance allowances in different standards and by the different base lines used by individual standards as dimensional reference points.*

Presented on May 1, 1957, at the Society's Convention at Washington, D. C., by Maxwell A. Kerr, Melpar Inc., Falls Church, Va.
(Received in final form September 22, 1958.)

Reasons for a New Inspection System

Print inspection is, at present, largely a matter of ear and eye judgment of general sound and picture quality under a variety of projection and viewing conditions. It is difficult to separate film faults from projector operation and setup troubles; therefore one objective is greater uniformity in the setup and operation of print-inspection facilities. *Process control* is properly the work of film-processing laboratories where a variety of precision tools are available for checking film and print dimensions, density and other characteristics. Such tools are not usually available to the customers who buy or lease release prints, and it is hard to justify the customer's making precision measurements. *Product inspection*, however, is properly the work of both customer and processing laboratory and should employ commonly available inspection and gaging devices and commonly accepted gaging and inspection limits.

Professional-quality 16mm projectors are now available from several sources.

*The drawing is too large and detailed for satisfactory reproduction in the *Journal*. Prints may be obtained at cost by direct inquiry to the author at 200 Meadow View Rd., Falls Church, Va.

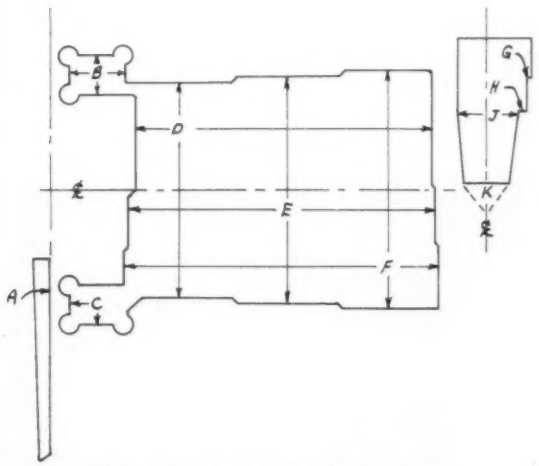

Fig. 1. Dimensions of original gaging aperture.

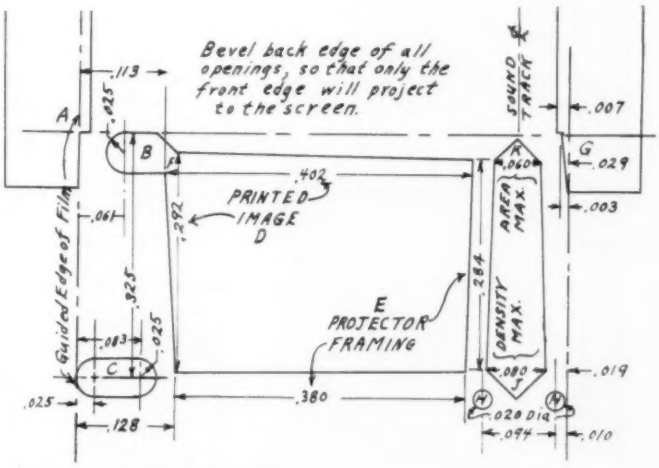

Fig. 2. Design of new gage plate.

Guide to dimensions: **A,** reference for all film guiding and horizontal dimensions (use centerline as reference for all vertical dimensions); **B,** see American Standard PH22.12-1953, dimensions C, D and E; **C,** see PH22.12-1953, dimensions B and E; **D,** see PH22.8-1957, dimensions A, B and C; **E,** see PH22.49-1946 (reaffirmed 1955), dimensions A and B; **F,** see PH22.46-1946 (reaffirmed 1953), dimensions A and C; **G,** see PH22.12-1953, dimension A with plus tolerance, and PH22.71-1957, $\frac{1}{2}$ of dimension A with minus tolerance; **H,** see PH22.41-1957, dimensions A, E and F, and note reading "Shaded areas to be effectively opaques in print"; **J,** see PH22.41-1957, dimension E; **K,** see PH22.41-1957, dimension C.

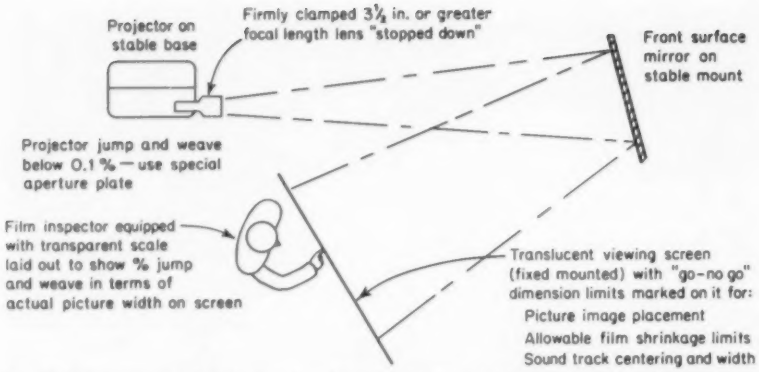
Projector on stable base
Firmly clamped 3½ in. or greater focal length lens "stopped down"
Front surface mirror on stable mount
Projector jump and weave below 0.1 % — use special aperture plate
Film inspector equipped with transparent scale laid out to show % jump and weave in terms of actual picture width on screen
Translucent viewing screen (fixed mounted) with "go–no go" dimension limits marked on it for:
Picture image placement
Allowable film shrinkage limits
Sound track centering and width

Fig. 3. Arrangement of projector, front-surfaced mirror and translucent screen for rear-screen projector with picture in reach of film inspector.

Tests with such projectors have demonstrated that gaging facilities of the required accuracy can be added to existing projectors, and that the associated projection inspection procedures can be combined with normal print reviewing to facilitate the obtaining of useful information while reviewing a release print.

Proposed Projector Setup

The first requirement is a *stable, solid mount* for the projector so that vibration on the mount will not be a cause of jump-and-weave in the projected picture. A projector with inherently *low jump-and-weave* in the film movement at the picture gate should be used. For example, the Navy-Type IC/QEB-1D projector is required to have picture jump of less than 0.2% of picture width. A loop setter incorporated in the design permits adjustment during operation to reduce jump to a minimum on each print projected. It also adjusts the throw of the claw-type intermittent movement to the optimum value for the particular shrinkage of the film being projected. Correct adjustment not only provides correct length of the bottom loop, but also reduces the amount of jump in the projected picture. Tests with this projector correctly adjusted showed that the measured jump at the projected sprocket hole can be held to 0.1% or less.

Steps for the operator to follow in making the projector setup are:

(1) Refit the projector with a special aperture plate, precision-ground and lapped to dimensions and shapes described in Figs. 1 or 2. The projector used in the tests has an easily removable aperture plate and pressure plate so that the special gaging plate can be quickly interchanged with the standard aperture plate at any time. The opening in the lamphouse casting must be enlarged to obtain light projection of all aperture plate openings. Some modification of the pressure shoe assembly may also be required.

(2) Use a solidly clamped projection lens of not less than 3½-in. focal length. Each end should be "stopped down" with disks. This is a simple means of using a standard projection lamp operating at normal color temperature to project a small picture, but with brightness at the projected picture reduced to the required amount as specified by ASA Standard PH22.100. It also provides the required sharpness and depth of focus to bring out the full resolution of any portion of a picture frame even on film that has been warped or curved by heat. The long focal length is required to make sure that dimensions of the special aperture plate will be projected in register with the film with an error of less than 0.002 in. for any of the gaging openings in the special aperture plate.

(3) Arrange the projector, a front-surfaced mirror and a translucent screen for rear-screen projector as shown in Fig. 3, and with the projected picture within reach of the film inspector. This allows the screen to be marked with "Go – No Go" limits on film and image dimensions and permits the operator to make jump-and-weave measurements on the projected images at the screen surface without shadow interference with any portions of the projected picture.

(4) Make a hand scale, based on the size of the final picture in each specific print-viewing setup, on transparent plastic. This is used for measurement of image jump-and-weave in terms of percentage of actual picture width.

Aperture Plate Design and Use

Figure 4 shows the projected outline of the aperture openings in the original gaging plate after six years of use by the Naval Photographic Center, Anacostia, Washington, D.C., for gaging print qualities.

Film registration during projection is determined horizontally by a fixed guide shoe at the sprocket-hole edge of the film, and vertically by the framing mechanism of the projector. When properly registered with the gaging plate, the sprocket-hole edge of the film will be just visible at A, and one sprocket hole will just fill the opening vertically at B in Fig. 1.

Film weave can be monitored also at opening A, and if the projector and its lens are well mounted the percentage weave can be measured with the plastic hand scale. This side weave should not be monitored at the film sprocket holes because of the side tolerance allowed in dimension E of ASA Standard PH22.12-1953.

Film and projector jump can be monitored and measured at B. Although this is the upper sprocket hole in the projected picture, it is actually the lower sprocket hole in the film frame at the picture gate and is closest to the pulldown mechanism in the projector.

Film shrinkage can be monitored at C. The lower edge of the projected sprocket hole should be compared with the lower edge of opening C, and the distance between should not exceed a predetermined limit. This is not intended as a precise measurement to replace use of a film-shrinkage gage, but instead merely as a warning device to tell when shrunken release prints should be withdrawn from general use.

Sprocket-hole weave can be monitored at the left-side edge of opening C by comparing it with film weave at the edge of A. Due consideration should be given to the tolerance allowed by ASA Standard PH22.12-1953.

Correct placement of picture image can be checked by comparing the projected picture-image edges with the edges of openings marked D and E. Dimensions for D are for a projector aperture in accordance with ASA Standard PH22.8-1957. Dimensions for E are for a printer aperture in accordance with ASA Standard PH22.49-1946 for printing to reversal stock.

Presence or absence of black framing around the picture image can be monitored at the edges of F. This opening is in accordance with requirements of ASA Standard PH22.46-1946 for use in printing positive prints from negatives. If negatives are not badly shrunk and are well centered in the printer, and correct printing aperture has been used, the black framing around the picture image will be visible at the edges of F.

Printer slippage between negative and positive will cause intermittent white edging in the black borders around the top and bottom of the picture image. This can also be detected at F.

Total jump-and-weave of the picture image due to all operations, including camera effects, can be gaged from fixed lines, such as long furniture pieces, contained in the projected scenes. Such gaging can be done only when the inspector has made certain that he is gaging on a fixed camera angle that was

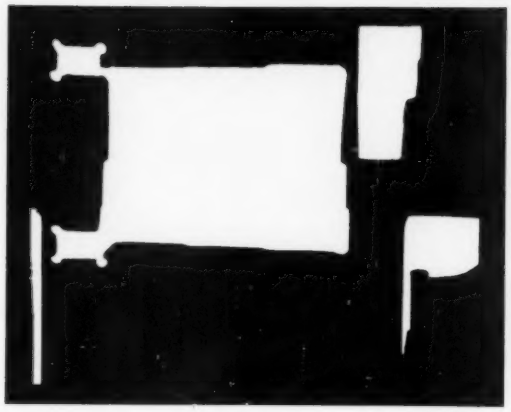

Fig. 4. Aperture openings in original gaging plate.

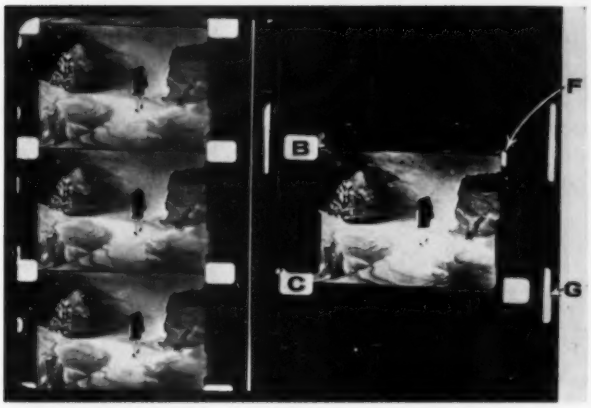

Fig. 5. Clip from master film on double-perforated stock showing shrinkage of film.

taken with the camera on a steady mount. An average should be taken of several measurements with the hand scale. The jump-and-weave of the projector, as monitored at B, should be subtracted from that measured in the scene to determine the amount due to camera and printer operation. These last measurements are easier to demonstrate than to describe. The ideas may be new to some, but the results give useful information on jump-and-weave effects *not* caused by the projector and serve to warn film processors and producers of growing troubles in printers and cameras.

Correct film width can be monitored at G in the opening at the right side of Fig. 1. The step shows allowed variation in width of new release prints which have been slit in accordance with ASA Standards PH22.12-1953 and PH-22.71-1957.

Film edge weave caused by film slitting can also be observed at G provided that the opposite film edge remains steady at A during this observation.

Presence of black septums or borders along the sides of the soundtrack can be monitored through the steps marked H in the upper righthand opening of Fig. 1. These separation strips should be black because the soundtrack side of the film is supported at the projector sprockets and the picture gate by these two narrow strips on either side of the soundtrack and are probably worn and scratched more rapidly than other parts of the film. This scratching, plus variations in projectors with regard to scanning beam alignment and length, soundtrack guiding, and use of prints with off-center soundtrack printing, can cause an undesirable amount of noise to be added during optical sound playback on poorly adjusted projectors.

Proper width and positioning of soundtracks, both variable-density and variable-area, can be monitored at openings J and K. Width K is full width for 100% modulation of variable-area tracks, and width J is full width for variable-density tracks according to ASA Standard PH22.41-1957. If the opening at K is made in the form of a V-slot as in Fig. 2, the apex of the V can be used as an easier means of checking accuracy of centerline placement on variable-area soundtracks. This is a particularly useful bit of information before deciding to add a magnetic half-stripe to an existing print. It should be remembered that any weaving of the edge of the magnetic half-stripe with respect to the centerline of the optical variable-area modulation will cause objectionable distortion of the optical sound playback, particularly during low-level passages.

Amplitude modulation characteristics of variable-area soundtracks can be monitored through the soundtrack opening at the upper right of Fig. 1, remembering that width K represents 100% modulation. The visual image for a particular sound appears in this opening approximately one second before the sound is heard.

Figures 5, 6 and 7 show the way film faults can be detected when viewed during projection through the gage plate. At the left of Fig. 5 is a clip from a master film on double-perforated stock after the film had shrunk too much for satisfactory printing operations. The view through the gage plate (right) shows the upper sprocket hole in register at opening B, but considerable lack of

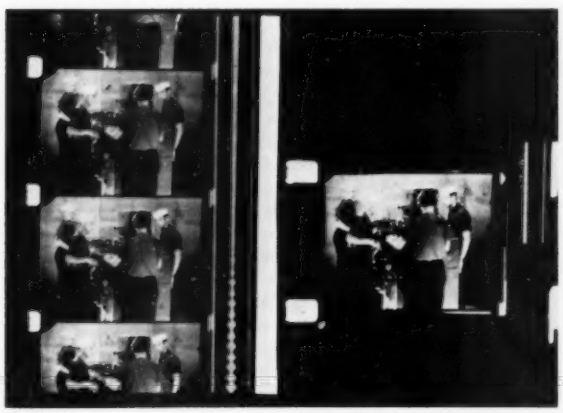

Fig. 6. View through gaging plate of release print from badly shrunk and poorly centered negative.

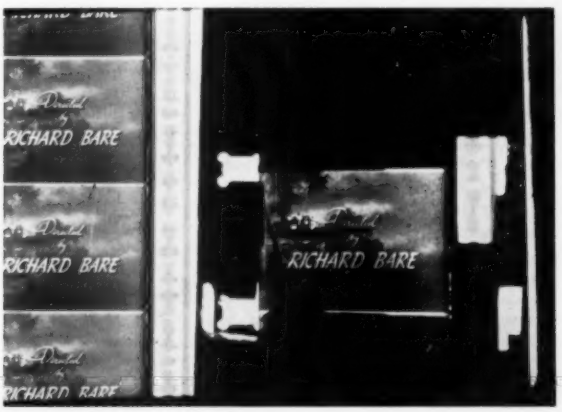

Fig. 7. Release print with over-modulated soundtrack and scratches along inside septum of soundtrack area.

registration of sprocket hole at opening C. The portion of opposite-side sprocket holes visible at opening F would probably show up in a release print.

Figure 6 shows a film clip plus view through the gaging plate of a release print which was printed from a badly shrunk and poorly centered negative. Note the print-through of sprocket-hole edges at right edge of pictures and that the septum areas on both sides of the soundtrack have not been fully blacked out.

Figure 7 shows a release print with over-modulated soundtrack and considerable scratching along the inside septum of the soundtrack area.

Simplified Design of Gage Plate

The gage-plate design of Fig. 4 works well in use but is difficult to make. Figure 2 shows the outline of a new gage plate design which is intended to retain as much as possible of the usefulness of the original design, while simplifying the machining operations. The letters at various openings and edges correspond to the letters in Fig. 1 and the same purposes and manner of use apply, with the following added information. Openings marked H are the full width of the septum areas on either side of the soundtrack. The edge at G has been tapered in order to better observe film width and weave in edge slitting. V-slots have been added at both J and K as a means of an easier check of the centerline accuracy and weave of variable-area tracks. More judgment is required in the use of the corners at D, E and F in determining proper positioning of picture image, proper choice of printer aperture during printing, and amount of printer slippage between negative and positive.

Acknowledgments

The author desires to acknowledge the very great help and encouragement received from the Navy Department, Bureau of Ships, the Naval Photographic Center at Anacostia, George Lewin of the Army Pictorial Center, and Ellis W. D'Arcy in carrying out this project.

Discussion

John G. Streiffert (Session Chairman): It seems to me that some of these measurements might be made more easily with the film stationary in the gate rather than with it running. In fact, there's so much information to be gotten from this film, that a considerable footage would be required. Items like shrinkage and track position might just as well be measured with the film stationary and perhaps with reduced intensity on the screen.

Jack C. Greenfield (who read the paper): It is my understanding that the primary application of this aperture plate would be, in permitting the visual detection of large-order print discrepancies "on the run," while using standard or high-speed inspection projectors.

Mr. Kerr (by mail, supplementing Mr. Greenfield's reply): The "Go–No Go" gaging during print review is not intended to replace static measurements with precise instruments as part of laboratory *process control*. It does provide a systematic way of gaining more information out of *product inspection* procedures common to both laboratory and customer. It might be likened to "early warning" radar as far as trouble-spotting is concerned.

A Flexible Lighting System for a Television Studio

By WILLIAM R. NEEDS and GEORGE GILL

A flexible lighting system has been designed to meet the needs of an active television studio. Two groups of rails provide flexibility in locating lights. Lighting is controlled from a production control console. Although the system was designed to meet the needs of a particular studio, in principle it can be adapted to a studio of any size.

THE LIGHTING system described here is extremely flexible and has been entirely adequate to meet the exacting lighting requirements for live productions in the studio for which it was designed. Although constructed specifically to fit the dimensions and to meet the requirements of WPST-TV, Miami, it can be adapted for use in a studio of any size which has similar requirements.

The studio is 52 ft wide, 80 ft long and 22 ft high. One corner of the studio wall is a curved glass window 30 ft wide. Production control is handled from a booth on the second floor from which there is a good view of the principal studio areas (Fig. 1).

Presented on April 25, 1958, at the Society's Convention at Los Angeles by William R. Needs WPST-TV, Miami, Fla., and George Gill (who read the paper), Century Lighting, Inc., Southern Branch, 1477 N.E. 129 St., North Miami 61, Fla.

(This paper was first received on March 17, 1958, and in final form on January 9, 1959.)

The system is based on a flexible grid composed of two groups of rails suspended 14 ft above the studio floor (Figs. 2 and 3). This arrangement permits each studio light to be positioned and angled for whatever type of lighting is required. The rails are of extruded aluminum I-beams (Fig. 4).

The first group of rails, known as the A group, forms the basic grid and consists of 25 20-ft rails and one 12-ft rail placed across the studio approximately six feet on center. The B group is composed of 44 rails 10 ft long. These are attached to the A rails with double carriers. The carriers roll along both the A and B rails and enable the B rails to be positioned and angled so that the lights can be placed in any desired location. Each light is attached with a single carrier to either an A or a B rail. An automatic brake prevents accidental movement of the equipment. A pole is used to release the brake to move the lights and the B rails.

Light Sources

For normal requirements in *back lighting*, 6-in. 500-w Fresnelites* are mounted on the B rails over the rear of the set. The lights are on carriers and both the carriers and the rails can be moved easily and angled to the desired position.

For *base and fill lighting*, 18-in. scoops* are used with 1000-w lamps and spun-glass diffusers mounted on single carriers by devices called Lite-Lifts.* These elevate the scoops to the desired height and can be pushed aside when not in use. The scoops are on carriers so that they can be rolled to any desired location.

For *key and special lighting*, 1000-w, 8-in. Fresnelites and pattern Lekolites (ellipsoidal spotlights with extreme control of the shape of the light beam) with 500-w lamps are provided. Each unit is mounted on a single carrier.

A number of pigtail outlets are used, rather than long extension cables which require considerable time to handle. Each of the A rails includes an outlet strip composed of a raceway with six 20-amp outlets spaced along the 20-ft rail. To provide for the increased il-

*Made by Century Lighting, Inc.

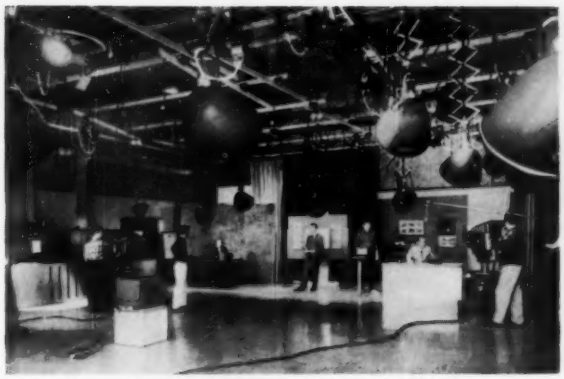

Fig. 1. General studio view.

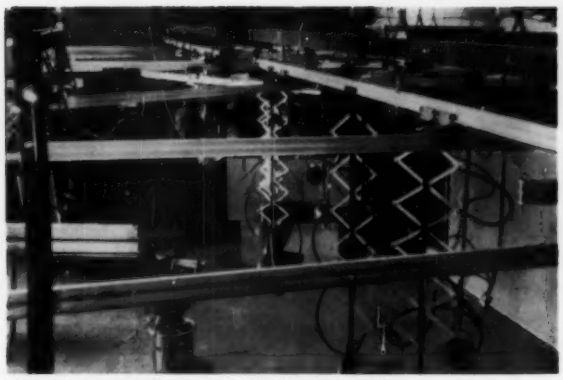

Fig. 2. General view of studio lighting grid.

lumination required for live color TV, each of the outlet strips has a 50-amp pigtail outlet located at the center. Altogether, 156 20-amp and 26 50-amp outlets are spaced around the grid.

There are ten wall outlet boxes ranged around the studio, each of which has one 20-amp and one 50-amp pigtail outlet of the same connector type as that used on the overhead grid, so only one type of cable connector is in use. The outlets, cables and lighting units have the equipment grounding system to provide maximum safety for studio personnel.

Two continuous cyclorama Mobilrails* are coordinated with the grid so that curtains can be placed at any location along the studio walls.

Lighting Controls

Simplified lighting control is sufficient for the studio's normal operations, but more complex lighting is occasionally required for certain productions, for which dual lighting control has been devised. Lights for normal productions can be preset so that the director can control them for each show with a minimum of effort. A Century Studio Lighting Console† is placed against the wall which contains the observation windows in what is the least-used show area. The console contains 12 50-amp no-dim control circuits and 12 6000-w interlocking dimmer control circuits. Each of the 24 control circuits feeds six outputs (Safe-T-Jacks) so that a maximum of 72 lights on constant voltage and 72 lights on dimmer control circuits can be used at any one time (Fig. 5).

The lights are connected to the circuits with a retractable cord and Safe-T-Plug which is inserted into one of the jacks of the appropriate control circuit. The lights can be grouped to a single control switch and handled from

†James W. Thompson, "Switching and controls for color and monochrome TV studios," *Jour. SMPTE, 65:* 643–645, Dec. 1956.

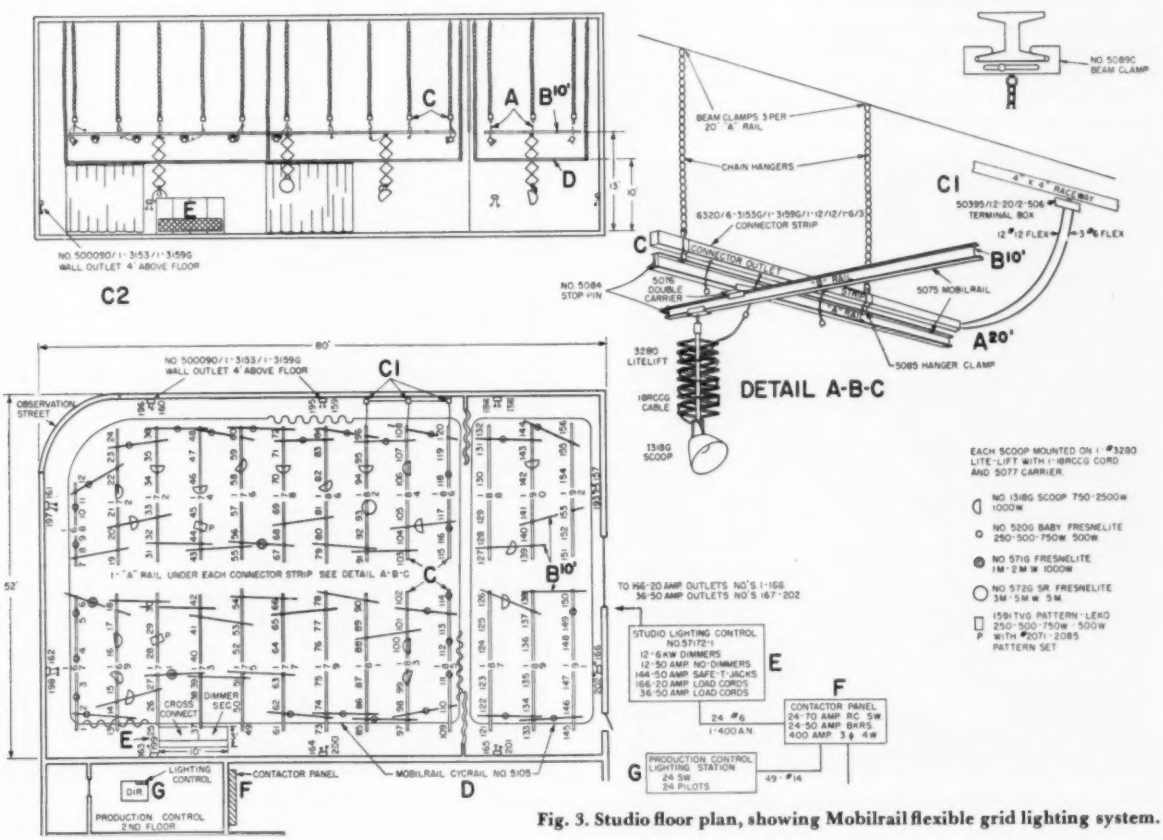
C2
C1
DETAIL A-B-C
80'
52'
OBSERVATION STREET
NO. 500090/1-3153/1-3159G WALL OUTLET 4' ABOVE FLOOR
1-"A" RAIL UNDER EACH CONNECTOR STRIP SEE DETAIL A-B-C
CROSS CONNECT
DIMMER SEC.
LIGHTING CONTROL
DIR
PRODUCTION CONTROL 2ND FLOOR
CONTACTOR PANEL
MOBILRAIL CYCRAIL NO. 5105
BEAM CLAMPS 3 PER 20' "A" RAIL
CHAIN HANGERS
CONNECTOR STRIP
CONNECTOR OUTLET
NO. 5084 STOP PIN
5075 DOUBLE CARRIER
5075 MOBILRAIL
5085 HANGER CLAMP
3280 LITELIFT
18RCCG CABLE
1318G SCOOP
NO. 5089C BEAM CLAMP
4" x 4" RACEWAY
50395/12-20/2-506 TERMINAL BOX
12#12 FLEX
3#8 FLEX
6320/6-3153G/1-3159G/1-12/12/1-6/3
EACH SCOOP MOUNTED ON 1-#3280 LITE-LIFT WITH 1-18RCCG CORD AND 5077 CARRIER.
NO. 1318G SCOOP 750-2500w 1000w
NO. 520G BABY FRESNELITE 250-500-750w 500w
NO. 571G FRESNELITE 1M-2M w 1000w
NO. 572G SR FRESNELITE 3M-5M w 5M
1591TVG PATTERN-LEKO 250-500-750w 500w P WITH #2071-2085 PATTERN SET
TO 156-20 AMP OUTLETS NO'S 1-156 36-50 AMP OUTLETS NO'S 157-202
STUDIO LIGHTING CONTROL NO. 5717Z-1 12-6 KW DIMMERS 12-50 AMP NO-DIMMERS 144-50 AMP SAFE-T-JACKS 156-20 AMP LOAD CORDS 36-50 AMP LOAD CORDS
24 #6 1-400 A.N.
CONTACTOR PANEL 24-70 AMP RC SW 24-50 AMP BKRS 400 AMP 3 ϕ 4W
PRODUCTION CONTROL LIGHTING STATION 24 SW 24 PILOTS
49-#14

Fig. 3. Studio floor plan, showing Mobilrail flexible grid lighting system.

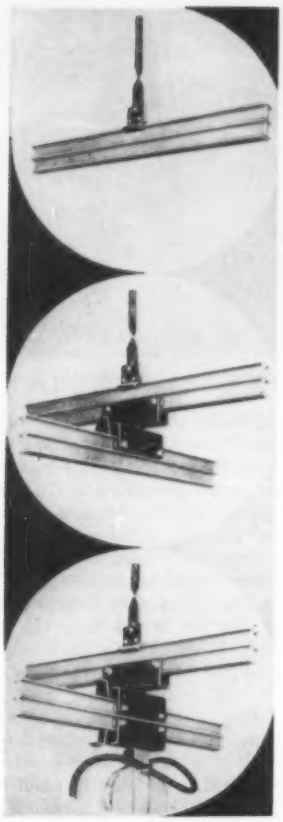

Fig. 4. Mobilrail — extruded aluminum I-beam — basis of the flexible grid lighting system for TV studios.

either the Director's desk or the studio console. Each of the load cords includes a circuit breaker which also serves as a switch to maintain control over each individual light.

When the lights are set for the scheduled shows, they are controlled by the Director from his desk in the production control booth. The Director's lighting control is a small panel (20 in. by 10 in. by 6 in.) located on the production control console along with camera switching and similar operations. A pilot light for each control circuit indicates the status of all the light groups. With this arrangement, which provides for day-to-day lighting, excellent results have been obtained with a minimum of time and effort. The floor console is called into use for more complex operations.

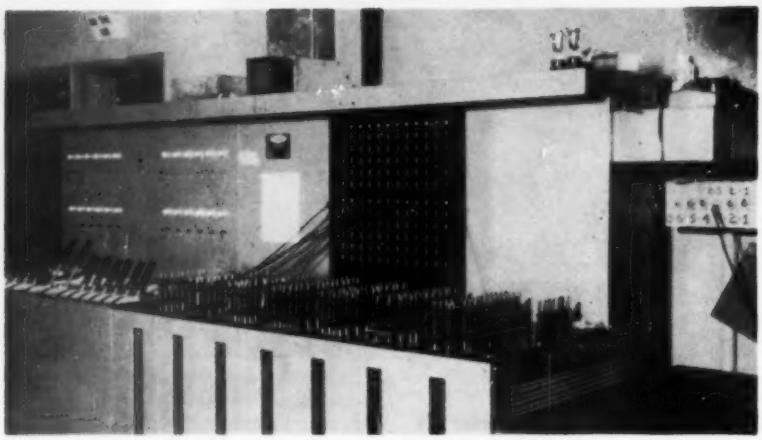

Fig. 5. Dimmer and cross connect console, located in studio.

A Century Contactor Panel, containing 24 70-amp remote-control switches, associated breakers, etc., controls the dual switching operations. The panel is located under a work bench in the maintenance shop.

This lighting system has been entirely adequate for present needs and will undoubtedly prove adequate for future requirements.

Acknowledgments

Individuals and organizations who aided in the design and installation of this system were: Stefan Zacher, Architect; Sasnett Engineering Inc.; Lowry Electric Co.; Century Lighting, Inc.; Inter-American Equipment Co., stage equipment; and Jack Barry, Production Manager of WPST-TV.

Discussion

Frederick Lewis (Telecircuit Corp.): Would you care to comment on the installation of your rail system in a studio equipped with closely spaced counterweighted battens for scenery, such as the Peter Clark system?

Mr. Gill: It was originally planned to install a certain number of "scenic battens" in this studio. The overhead structure of this studio has the I-beams positioned so that head blocks and counterweight rails can be added. It seems unlikely that this system will in any way interfere with the use of scenic battens, inasmuch as the space between the A rails is completely free when the B rails are pushed to one end or the other of the scenery which would be hung on the scenic battens. It would then be possible to get between two of the A rails' scenic battens and you would have a B rail approximately 90° perpendicular to the scenery at each end which would provide more spaces for side-lighting than is possible without the use of the system. In addition, the ability to slide the lights along the A rail parallel to the scenic batten is an advantage which normally does not exist. I can see no reason why the use of scenic battens should in any way invalidate this system. I believe that it is workable, with either overhead scenery or free-standing scenery. I have found that free-standing scenery is being used increasingly in the television stations along the Eastern seaboard. I don't know if this holds true throughout the country, but there does seem to be a growing trend toward the use of free-standing or built scenery.

There also seems to be a tendency to have more of the sets in the center of the studio while working completely around them so that, for example, the camera can shoot through a window or a fireplace. Certainly this system would be applicable to that type of production.

Mr. Lewis: A great many of the small studios regard dimming as an unnecessary luxury. You seem to have devoted 50% of your controlled circuits to dimmable circuits — would you like to comment on how you arrive at a formula for determining the ratio of dim to undimmed circuits as a function of the studio size or operation?

Mr. Gill: I am glad you asked that question. Many, many times I have been told that we do not need dimmers because this is a small studio. I can't see where the size of a studio determines whether you should or should not have dimmers. In fact, under certain conditions, dimmers might be more useful in a small studio than they would in a larger one. Most people also feel that dimmers are required solely for theatrical dimming effects. I believe that dimmers are used more to balance lights than to obtain so-called theatrical effects. There are several ways of balancing lighting. In photography, it has been the practice to change the bulb if a variety of wattages can be used in a fixture or to add or remove scrims. There are single scrims and double scrims. You could add a scrim or change the wattage of a bulb or you could move the light closer to or farther away from your subject.

Now, these three methods of varying the intensity to balance lighting certainly are not creating lighting effects, that is, dimming effects, but are merely being used to balance light to obtain an acceptable picture. Each method requires time and effort. With a dimmer, it is possible to adjust and balance the lighting at one central point quickly and easily. As to the formula for determining the number of dim and undimmed circuits — I have found 50% to be workable on the basis of past experience.

Preset Reloading–A New Approach to Television Lighting Control

By WILLIAM M. RICHES

The low-voltage, remotely controlled preset programming system for load switching, developed by CBS Television, promises to be the solution to the demands by color television and by the more complex black-and-white shows for more and higher-capacity dimmer units, and eliminates the physical reloading of dimmer circuits during broadcasts. It offers a considerable reduction in capital investment for production lighting facilities in future installations.

At the end of 1956, the problem facing the Columbia Broadcasting System at Television City, Hollywood, was that of meeting the heavier lighting requirements of the more complex black-and-white shows and of the color shows with the limited load facilities of the television lighting-control systems installed in 1952.

Two of the four 109 by 110-ft production studios at Television City were constructed as audience-participation studios with permanent seating and were equipped with 60 5-kw thyratron dimmable production lighting circuits and 40 5-kw nondimmable "hot circuits." The two nonaudience studios with larger production areas were equipped with 90 5-kw thyratron dimmable circuits and 60 5-kw hot circuits. The permanent seating in one of the audience-participation studios was later removed, the production area was increased in size, and 30 dimmable and 20 hot circuits were added. These circuits may be connected through a multireceptacle patch panel to approximately 530 overhead and floor outlets for connection of lighting units. Each of the dimmable circuits may be controlled by a manual dimmer control board or through a five-section preset potentiometer dimmer panel and cross-fader. In addition, any of these dimmable circuits may be controlled through any of four manual submasters or one grandmaster controller.

Despite this complexity of control, it was found that because of the greater number of lighting units required by the more complex black-and-white shows and the higher light levels required by color shows, the number of dimmers required throughout a show often exceeded the total installed dimmer capacity; occasionally, the facilities of both the installed dimmers and the hot circuits were exceeded. In this situation it was necessary to physically "repatch" the load cords part way through a show, disconnecting at the patch panel those load cords that were feeding sets on which production had been completed and connecting those load cords supplying sets still to be televised. This was hazardous to production continuity as well as time-consuming; an error in repatching during broadcast could be disastrous, and often repatching had to be done in a minimum of time.

An examination of existing lighting methods showed that a dimmable or hot circuit might be utilized by one or more lamps for only one scene during an entire show, preventing further use of that circuit unless it was physically reloaded with a different group of lamps for subsequent scenes. Thus, the efficiency of use of these circuits was very low. However, it was uneconomical to provide sufficient circuits to light an entire show without reloading, and frequent physical reloading of circuits was impractical.

Development of Reloading System

In the fall of 1956, Lighting Director Leard Davis and Production Lighting Maintenance Foreman Jim Oakerson suggested accomplishing the reloading operation by means of load-switching

Presented on April 25, 1958, at the Society's Convention at Los Angeles by William M. Riches, CBS Television City, 7800 Beverly Blvd., Los Angeles 36.
(This paper was received on March 17, 1958.)

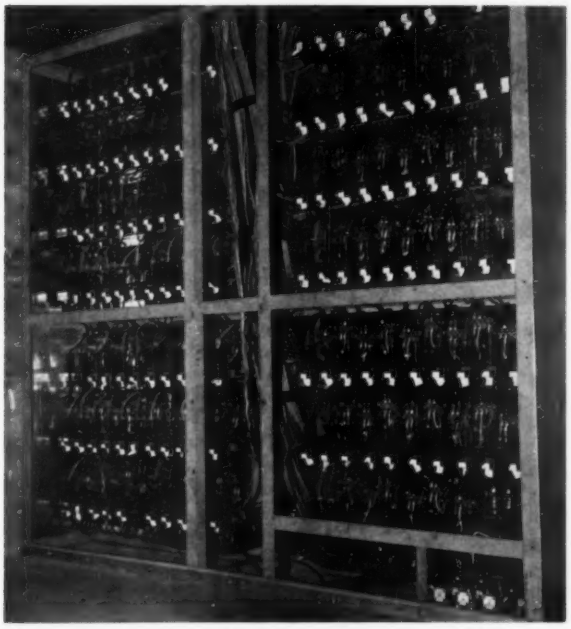

Fig. 1. 150-Circuit reloading relay cabinet remotely located in dimmer room.

Fig. 2. 150-Circuit preset reloading console with removable platens.

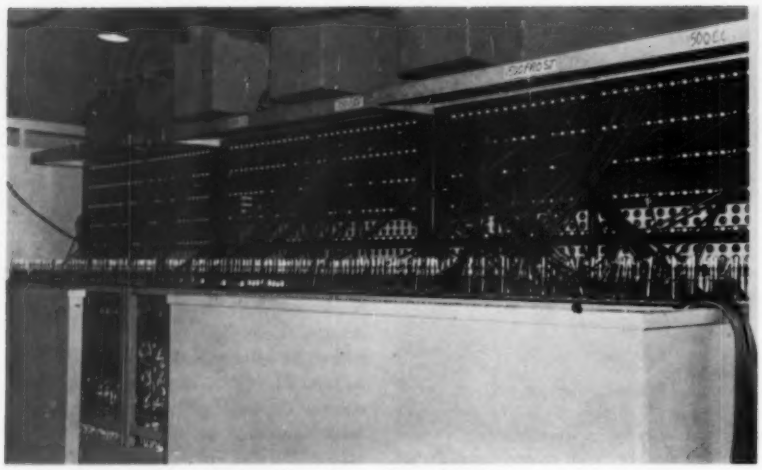

Fig. 3. Three-section, 150-circuit patch panel, Studio 43.

mercury relays mounted five to a unit in portable assemblies on the front of the patch panels; these relay units would then be connected between the patch panel and the load cords feeding the studio outlets. Each assembly would be equipped with its associated load cords and a five-position selective pushbutton station for control of the relays. In operation, each circuit connected to these multipliers could be reloaded five times, requiring operation of the appropriate pushbutton on each unit to accomplish each reloading.

This basic approach was further developed by CBS personnel at Television City during 1957. The portable relay assemblies were redesigned into one main relay cabinet (Fig. 1) for each studio, with its individual power supply, remotely located in the dimmer rooms below the studios. The reloading patch cords were permanently built into the existing patch panels and were equipped with retractable assemblies. The individual pushbutton stations were first redesigned into a five-position preset pushbutton console with one master pushbutton, which was in turn replaced with a three-platen preset programming pegboard console with one master preset selector pushbutton station located at the main production lighting console. Finally, pilot lights were added to the programming console (Fig. 2) to serve as a programming check and to assist in locating trouble. By this system, the load cords to be repatched or reloaded may all be connected prior to the show, and the load switching may be set up on the remote preset programming board. The function of repatching is then controlled by the master pushbuttons, and any number of repatches may be accomplished simply by plugging in additional preset programming platens. In this form the Preset Reloading System was installed in four studios at Television City in the spring of 1958. Credit must be given to Lawrence Grundy of Fischbach & Moore, Inc., prime contractor, and to Louis Erhardt of Century Lighting, Inc., subcontractor, for their contributions to the development and installation of the CBS Preset Reloading System.

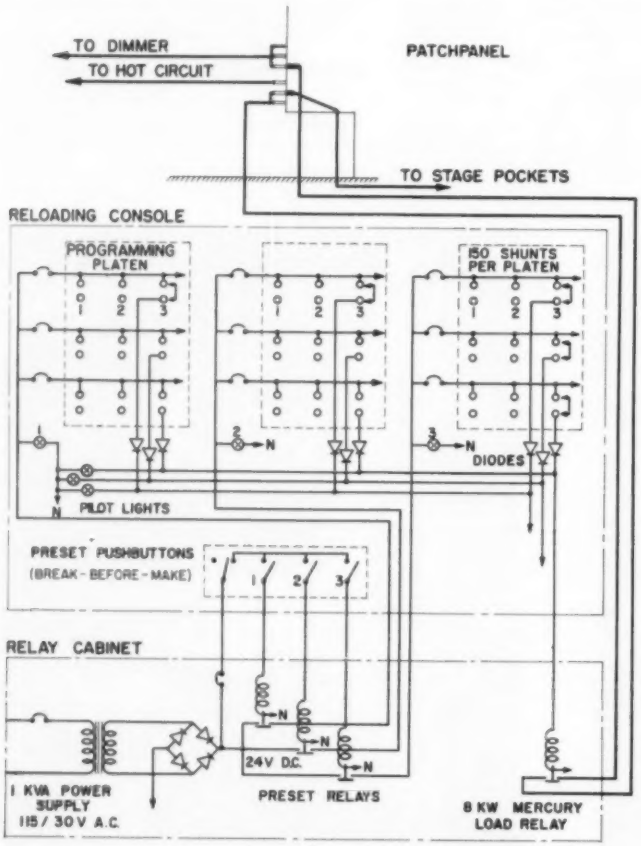

Fig. 4. Schematic of load and control circuits of the Preset Reloading System.

Design and Operation of the Reloading System

One-hundred and fifty reloading relay units were installed in Studios 41 and 43, which have three-section patch panels; however, because of the physical limitations of the two-section patch panels in Studios 31 and 33, only 100 reloading relay units were installed in these two studios. Figure 3 shows the Studio 43 patch panel, which is divided into three sections, each section containing 90 three-receptacle dimmer circuits and 60 three-receptacle hot circuits. Each group of three receptacles is paralleled to its respective circuit in the adjoining sections, making nine receptacles per circuit. In this studio, 150 hot-circuit receptacle buses at the rear of the patch panel were cut and two of the three receptacles were converted to reloading receptacles which can be identified by the light-colored numbering strips in the illustration. This provided 300 reloading receptacles for connection of load cords feeding the stage outlets; 240 of the original 540 receptacles remained as hot-circuit receptacles. A number of spare load cords located on the horizontal portion of the patch panel were converted to reloading cords, connecting to the reloading relays, and the required additional number of cords were added to make a total of 150 reloading cords.

The load and control circuits of the Preset Reloading System are shown schematically in Fig. 4. As many as nine reloading cords from the bench section of the patch panel may be connected into the nine receptacles of any one dimmer or hot circuit on the vertical section of the patch panel. These circuits are individually switched through 8-kw mercury relays and feed the reloading receptacles at the patch panel, into which may be connected any of the load cords feeding the lighting outlets on the overhead battens or any of the floor outlets throughout the studio. This provides reloading of any one dimmer or hot circuit nine times, and for a studio with 150 such reloading circuits would permit simultaneous reloading of 16 circuits nine times, 30 circuits five times, 50 circuits three times, or any similar combination.

The heart of the 24-v control circuit is the American Marine Products (AMP) Type 695003-1 "Patchboard Programming Board." The AMP unit is a two-piece multicontact jackfield mounted in a fixed position with the preset reloading pattern set up with shunt plugs on a removable programming platen. One such unit is required for each reloading. Three AMP units are provided on the control console for each studio, allowing the initial loading and two reloadings of dimmer or hot circuits; further reloadings may be accomplished by exchanging the original platens with spare preset platens supplied with each console. Three master reloading "break-before-make" pushbuttons are provided with each console, one button energizing each preset programming unit. A pilot light in the control circuit of each load-switching relay gives indication of the reloading pattern selected during any reloading operation. Feedback between presets is prevented by the use of silicone diodes in the control circuit.

Planning a Show Using Preset Reloading

To achieve the most efficient use of dimmers and hot circuits with preset reloading requires a certain amount of planning by the lighting directors. Lighting units used throughout an entire show are assigned directly to dimmer or hot-circuit receptacles at the patch panel, while lighting units used for only one or two scenes are assigned to dimmer or hot circuits which are to be controlled by the load-switching relays of the reloading system. For example, in a production-type show, if it were found that five scenes throughout the show required 20 5-kw circuits for only a short time for each scene, then 20 circuits would be assigned for reloading purposes and 100 reloading cords at the patch panel would be connected to these 20 circuits. Five different loading patterns of 20 circuits each would be set up on five reloading platens. For a dramatic show requiring a different sequence of load circuits for each scene, one platen for each scene could be set up with the proper load sequence for that scene, and the same dimmer or hot circuits could be used many times.

Consider a dramatic show of 15 scenes, each scene requiring 50 kw of dimmer capacity, or ten 5-kw dimmer circuits. Ordinarily, this would require 150 5-kw circuits; however, with preset reloading, 30 dimmer circuits reloaded five times would easily handle the show. With the reloading console containing three reloading units, this would require the changing of two preset programming platens.

Application of Preset Reloading

Since the reloading system was installed a year ago, it has been used on approximately 50% of our *Playhouse 90* productions which are among our most complex types of shows. For example, on the *Child of our Time* show of February 5, 1959, 34 of the 90 available 5-kw dimmer circuits and 92 of the available 100 reloading relays were assigned for reloading purposes. Four platens were used and most of these dimmers were reloaded four times. In these cases a total connected load of 20 kw throughout the show was handled by each of the 5-kw dimmers. Ordinarily, this would have required an additional 60 dimmers, or a total of 150 dimmers, to light the show without physical or preset reloading.

During the past year, the reloading system has been used on approximately 15% of all productions originating at Television City, and had we not already had the existing number of dimmer and hot circuits already installed, this system would have been used even more extensively.

From the experience gained since its installation, we have found that not only can we re-use our dimmer and hot circuits repeatedly, but also we can multiply our five-scene preset potentiometer control panel into 10 or 15 scenes of preset. Ordinarily, each scene of preset dimmer controls contains 90 circuits which are all controlled in the on-off position simultaneously. If only 30 circuits are required during one scene of preset, the other 60 circuits in that scene are useless, since they are controlled with the first 30 circuits. However, by coordinating our preset reloading controls with the preset dimmer controls, we can group any of the 90 circuits within any of the five scenes of preset and thus multiply our five-scene, 90-circuit/scene preset dimmer control panel into 10, 15, or 20 scenes with a variable number of circuits within each scene.

Effect on Future Television Lighting Control Systems

It is expected that preset reloading will be the heart of any future overall television lighting-control system, and that by its use future installed dimmer-circuit requirements may be reduced by as much as 50% and hot-circuit requirements may virtually be eliminated. Application of the reloading principle to the control circuits as well as to the load circuits would make this possible. This new approach to lighting control, therefore, has far-reaching results. With the reduction in numbers of dimmer circuits, there would be a reduction in numbers of control circuits, a reduction in space requirements at the control consoles (which is now becoming a problem), a reduction in the size of the patch panel, and a reduction in space requirements in the dimmer rooms; the capacity of the transformers, switchgear and load centers supplying power to the studio lighting could be reduced, and the air-conditioning load in the dimmer rooms would be reduced. This would all be reflected in considerable saving in capital investment and operating costs.

The B.B.C. Television Standards Converter

By T. WORSWICK

After outlining the background of the standards conversion problem in European TV, the design and performance of the British Broadcasting Corp. standards converter are described. This converter comprises a high-quality display of the incoming (625- or 819-line) picture which is presented to a TV camera using a 4½-in. image-orthicon pickup tube (P812) on the British standard of 405 lines.

IN EUROPE there are three video television standards: 405-line (British), 625-line (CCIR), and 819-line (French and Belgian). The B.B.C. standards converter station at Dover converts pictures incoming from Europe on 625 or 819 lines to 405 and also operates in the outgoing direction from the 405-line standard to 625 lines. The converters comprise a high-quality display presented to a 4½-in. image-orthicon camera. The distortion added by the conversion process is small.

Historical

Public service television started in Europe in 1936, when the British Broadcasting Corporation opened its station at Alexandra Palace with a system using 405 lines, 50 fields, 2:1 interlaced. At that time such a standard was a bold step and certainly exceeded the performance of the camera tubes and the displays then available. War interrupted this service and at its cessation it was decided that the 405-line standard should be continued in Great Britain. The extension of the service began and the sale of receivers increased.

Other European countries who had no established television services felt that with the rapid developments made during World War II on television-type techniques, such as radar, an improved television standard should be sought and if possible agreed upon internationally. In France a decision had been made to use a standard of 819 lines, 50 fields, 2:1 interlaced but all the other countries finally agreed that the number of lines should be 625, 50 fields, 2:1 interlaced.

For the countries adopting the 625-line standard the problem of exchange of program material, from the technical point of view, was merely that of providing suitable international links. The problem of program exchange between countries on different television standards remained unresolved.

The British television service was developing fast and in 1951 B.B.C. cameras on the 405-line standard, with the cooperation of the French authorities, were taken to Calais and a program broadcast direct from there to viewers in Great Britain. The success of this program stimulated serious thought on the problem of standards conversion that would make it unnecessary to carry cameras of different standards to program points in Europe.

The first converter was installed by the B.B.C., again with the friendly cooperation of the French, on a hilltop at Cassel, in France, inland from Calais, about 40 miles from Dover. A series of transmissions from Paris to England ensued for a whole week in July 1952.

In 1953 a concerted effort by a large number of countries brought into being the Eurovision network for international program exchange and therefore a permanent standards converter was installed at Dover at the terminal of the cross-Channel radio link. This converter was designed to accept incoming signals on either of the Continental European standards, i.e., 625-line CCIR or 819-line French.

In 1957 the B.B.C. installed a converter 405 – 625 lines in the outgoing direction, England to Europe.

Specification for a Standards Converter

Ideally a standards converter should be a "black box" into one terminal of which is fed a television picture on one standard and almost simultaneously (with a delay of say not more than one television field) the same picture on another standard should appear on the output terminal.

The loss of resolution should be negligible, bearing in mind that the resolution both horizontal and vertical can at best be only that of the television standard which is lower in this particular respect.

The contrast law should be linear and the noise added by the conversion to the signal should be negligible.

It is also desirable that the field frequencies of the signals on each side of the converter should not require to be rigidly locked to one another. For example, it is preferable that on the output of the converter at Dover the field frequency is locked to the British electricity supply frequency although the incoming signal from, for example, France is referred to the French supply frequency which may on occasion be as much as 1 c/s different. The equipment must be uncritical in adjustment and stable in operation.

The Problem of Standards Conversion

The fundamental problem of standards conversion is one of storage. The information in the television signal at the input to the standards converter must be stored in a convenient form until it is required for transmission to the output of the converter.

That is to say, the incoming television signal on the input standard must "write" the information which is then stored until it is "read" by the output scanning standard. The stored information is ideally also erased as it is read.

Several proposals have been made for television standards converters but the only ones which have been successfully operated in practice have consisted in essence of a picture display on one standard presented to a television camera on another standard.

The storage mechanism is obtained by the use of a long decay phosphor on the display tube or by operating the camera tube to give field storage or by a combination of both.

The various standards converters in Europe have differed only in their choice of camera pickup tube. In chronological order they are:

(a) image orthicon (B.B.C. at Cassel in 1952 and Dover 1953);

(b) iconoscope (Dutch at Breda 1953, also French in Paris); and

(c) vidicon (German at Cologne 1958).

There are differences in detail of the mechanism of conversion so the description which follows is restricted to the case of the image orthicon, which is described fully by Lord,[1] but for completeness it is outlined briefly here.

There are three main considerations:

(a) the relation in time between the display or writing spot and the camera or reading spot;

(b) effects due to the field-repetition rates on the input and output sides of the converter not being at exactly the same frequency; and

(c) interference or "strobing" patterns between the line structures of the two television standards involved.

The first consideration involves the storage characteristic of the pickup tube target. If the image orthicon is operated below the knee of the characteristic

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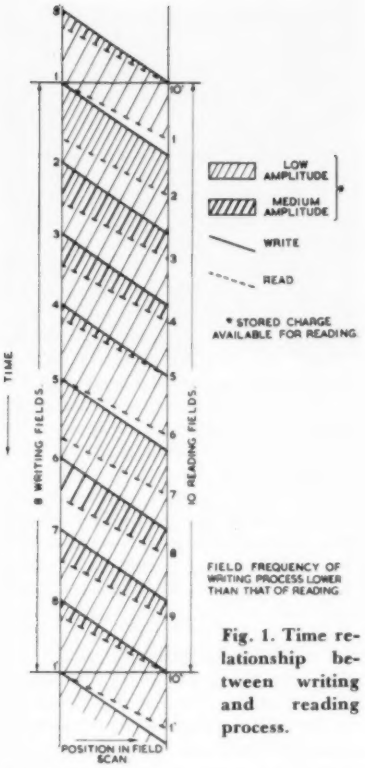

Fig. 1. Time relationship between writing and reading process.

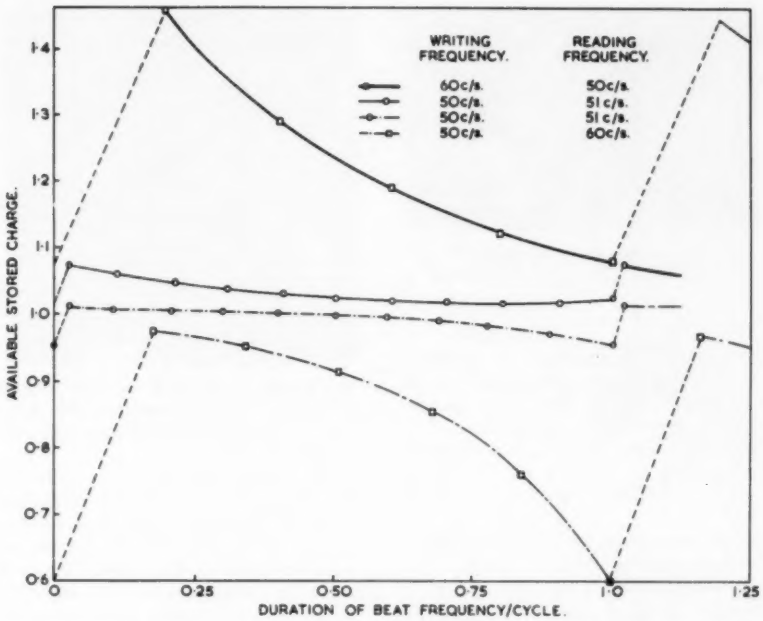

Fig. 2. Curve showing relation between flicker amplitude and difference between field frequencies for 7-msec display phosphor.

then there will be storage for the whole field and if the field frequencies of the writing and reading spots are locked it will not matter what their phase relation is. This, of course, assumes perfect storage and complete erasure of the image by the reading spot.

If however the field-repetition rates on the two sides of the converter are different the phase relation between the writing and reading spot is continually changing.

Zworykin and Ramberg[2] have pointed out that for an upward change of field frequency through the converter there will be no signal in certain fields of the output. For a downward change of field frequency there will be a double amplitude signal in certain fields of the output.

This can best be illustrated by Fig. 1 which refers to the case where the input field frequency is lower than the output. It is assumed that the signal is written on the target instantaneously and that the writing signal is rendered structureless by the use of, say, spot position modulation.

The sloping solid lines represent the period of one field in the writing signal. The sloping dotted lines represent the reading process which we assume to be interlaced and of high resolving power so that there is no interference between the lace and interlace fields though complete erasure takes place. Also if we assume that the charge storage is perfect until it is erased it will be seen that on reading field 1 the signal will be of an amplitude due to writing field 8′ which is lower than that, for example, of reading field 4 which reads charge storage from writing fields 2 and 3. In fact, for a ratio between writing and reading fields of 8 to 10 we get a sequence of fields 1,2,6,7, of the reading signal of an amplitude due to one writing field and fields 3,4,5,8,9,10, with a signal of double amplitude due to two writing fields.

Such a variation of amplitude would give a 50% flicker at the difference frequency between the two fields. A corresponding variation of amplitude occurs when there is a downward change in field frequency.

If however the writing process is made more nearly continuous by the use of a long-decay phosphor on the display tube the flicker problem is considerably ameliorated. A curve taken from Lord is shown in Fig. 2 which shows the relation between the available stored charge over the period of one cycle of the difference frequency between the field frequencies when the decay time of the writing phosphor is 7 msec.

It will be seen that for a one-c/s difference of field frequencies the flicker amplitude is about 3% but for a 10-c/s difference it is about 24% for an increase of field frequency and about 15% for a reduction of field frequency.

With the small differences in field frequency which in practice occur between the two sides of the converter these flicker defects are quite negligible.

The use of a long-decay phosphor brings in an incidental advantage in another respect. An image-orthicon tube operated well below the knee ignores short time variations of the total input light flux. Above the knee, because storage is no longer complete, some signal will appear in the output which is a function of any variation in total light flux from the scene.

The transition between full storage and incomplete storage in the region of the knee is gradual so that in practical operation in an endeavor to obtain the best signal-to-noise ratio it is possible to overexpose the tube slightly into the region of incomplete storage.

In the standards converter if the image orthicon were operated above the knee then a signal related to the brightness variations of the display spot would appear in the output. The use of the long-decay phosphor reduces the effective depth of modulation of the brightness of the display spot so that the interference signal is also proportionately reduced to the extent that the total effect is quite negligible.

If the geometry of the television pictures is not perfect there will be the familiar beat pattern between the two line structures. This is obviated in practice by removing the line structure with spot-position modulation on the display monitor, so that a "smooth" picture is presented to the camera. A modulation frequency of about 10 mc is used.

The amount of spot-position modulation depends on the line-to-line pitch

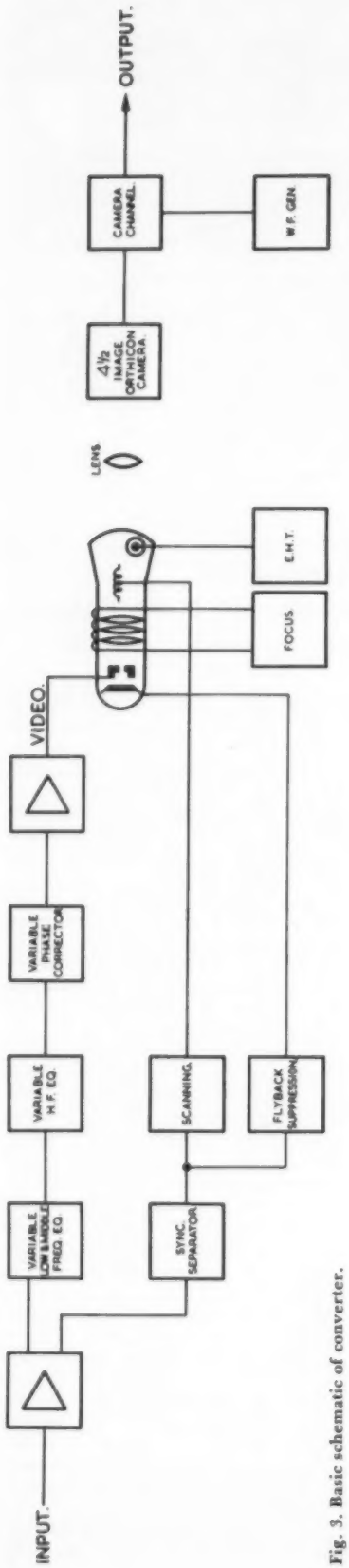

Fig. 3. Basic schematic of converter.

in the scanning structure. Any variation of field linearity, therefore, will mean that the spot modulation will not be effective in all parts of the picture to the same degree and the line structure will therefore be apparent. Where this occurs the beat pattern will be visible. It is essential therefore that particular attention is given to obtaining very good linearity of field scans (better than 1%).

Description of the Converter

The basic schematic of the converter is shown in Fig. 3. The signal from the input is divided into two separate paths (a) to the scanning generators and (b) to the video input of the display so that adjustment may be made on the video signal without disturbing the display synchronization.

The display tube has a 9 in. diameter flat face and uses a willemite phosphor tube, Type Cintel C 106 J. Willemite gives a satisfactory spectral response for use with the pickup tube. Toroidal scanning coils and careful alignment of the focusing magnet give a very fine anastigmatic spot all over the raster with an E.H.T. voltage of 14-kv and a maximum beam current of the order of 100 μamp. Spot-position modulation is obtained by passing a 10-mc current through a separate winding on the scanning coils. The amount of current is adjustable. The video signal is clamped line by line at the grid of the display tube so that drift of black level does not occur. This also removes low-frequency interference on the vision signal.

The aperture loss due to the display tube spot is small, and as a matter of strict routine the tube face is kept clean to keep down halation due to dust.

The camera lens was chosen to give good resolution all over the field at the working magnification. The resolution is defined as the depth of modulation of black-and-white patterns corresponding to the limiting resolution of the television system and not the ultimate resolution of the lens. It is well known that a lens may give some resolution far beyond the limit of the television system but give a relatively poor response at the top end of the video band.

The effects of lens halation are small because the contrast ratio of the display is about 5:1.

The pickup tube chosen is the English Electric P812 image orthicon (4½ in.). This tube has several features which make it very attractive from the point of view of a standards converter.

As is mentioned above the tube must be operated just below the knee of its characteristic and therefore the signal-to-noise ratio of the overall converter is limited by the pickup tube. The P812 has an intrinsic signal-to-noise ratio of the order of 44–48 db when operated below the knee.

In addition, the resolution is very good, the aperture loss due to the tube being about 2 db at 500 lines.

The target mesh spacing is very close, less than 1/1000 in., so that the usual image-orthicon edge effects are absent. The tube is subject to some lag on fast movement but as lag has already had to be introduced for other reasons on the display phosphor this defect is not a handicap.

The sensitivity is quite adequate so that with a modest lens aperture ($f/4$) the highlight brightness required on the display tube is 25 ft-L which is low enough to make it relatively easy to obtain a fine spot on the display tube.

The design of the apparatus comprising the converter is straightforward. Components are conservatively rated and particular attention has been paid to stability so that continual adjustment of controls is not required. Scan amplitude constancy is important so that the picture framing does not change. The display tube potentials are closely stabilized so that the operating conditions do not vary.

On some transmissions considerable noise on the incoming signal has been encountered and reasonable protection against this has been provided by using blocking oscillators following the synchronizing signal separators. Flywheel sychronization was considered but at the time of the construction of the apparatus signal, interruption was a frequent occurrence, and it was thought that the recovery time of a flywheel after a disturbance was unnecessarily long.

Because the converter is energized from a mains supply which is not synchronous with the incoming field waveform, it is essential that the equipment is hum-free, with regard to amplitude hum in the picture chain and positional hum in the scanning. The amplitude hum is better than 50 db below picture and the positional hum better than 0.1% picture height or width.

The line scanning output stage uses three tubes in parallel with feedback from the current in the scan coils back to a previous stage. Economy circuits were not used because it was desired to have good linearity independent of amplitude of scan and also a line speed which could be 15-kc or 20-kc (625- and 819-line system).

The picture display monitor is mounted in a frame 7 ft, 6 in. high with a standard 19 ft width, the picture tube being located horizontally about 4 ft from the ground.

The camera stands on a bridge-like frame bolted to the vertical frame so that its lens is correctly placed with respect to the picture tube. The camera can be slid back from its working position to facilitate the changing of the pickup tube.

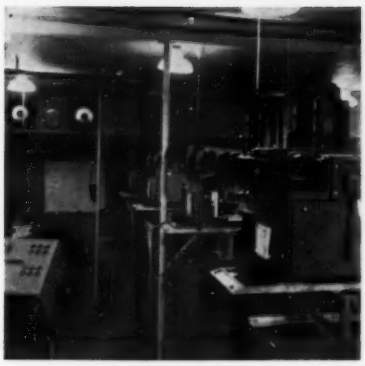

Fig. 4. Dover converter; cameras facing displays.

Fig. 5. Dover converter; camera control racks, input and output display monitors, variable equalizers.

The camera itself is a standard Marconi Type BD687 with the filter wheel removed and with all gamma correcting circuits out of action. Figs. 4 and 5 show the converters installed at Dover.

Operating Conditions and Overall Performance

To obtain the best results with the converter, care in the adjustment of the various components of the chain is all important, particularly in the optical section.

The level of the incoming signal is adjusted to the standard level (1 v) and the contrast and brightness of the display are adjusted, so that the white in the picture is at a brightness of 25 ft-L and the black at 5 ft-L. The lens aperture is $f/4$. This puts the brightness range of the displayed picture just below the knee of the pickup image orthicon, i.e. on its linear characteristic.

The setup in the camera channel is adjusted so that the black in the picture is at pedestal level and the gain is adjusted so that white has the appropriate value.

Under these conditions the overall amplitude/amplitude transfer characteristic is approximately linear.

It is essential that all focus adjustments are accurately set: (a) the display focus, (b) optical focus (c) image focus and beam focus in the pickup tube. In practice a good method for checking focus is to remove the spot-modulation signal thereby permitting the maximum visibility of beat pattern between the two raster structures. Each focus in turn is then adjusted for maximum visibility of beat pattern. After this is done the spot-modulation current amplitude is increased until the beat pattern disappears. In practice the amount of spot-position modulation for an 819-to-405 line conversion is almost nil and a modest amount is needed for a 625-to-405 conversion. The most, amplitude equal to line pitch, is used when converting 405 to 405 which is occasionally done when checking overall performance and other parameters of the converter.

With all adjustments correctly made then the performance of the converter is on the average as follows.

(*a*) *Resolution*

No. of picture elements horizontally	*Depth of modulation of graticule assuming 100% on input*
170	100
250	100
330	100
420	80
500	60

(*b*) *Signal-to-Noise Ratio:* Assuming a perfect signal on the input, the noise on the output will be only that due to the pickup tube which is 42–46 db peak signal/rms noise. This is approximately 2 db less than the intrinsic noise of the tube because the input contrast ratio is only 5:1.

(*c*) *Contrast Law:* With a linear sawtooth applied to the input, the sawtooth on the output is linear within 2% of the peak value with no sudden discontinuities (see Fig. 6).

(*d*) *Stability:* The converter has been found to be reasonably stable in practice and often a long transmission is carried on one converter without adjustment, though it is usual practice to operate two converters in tandem and to select the one giving the better result for transmission to the network.

(*e*) *Movement Blurring:* This is difficult to define quantitatively so a description must suffice. On static scenes, interviews, slow moving processions, etc., the movement blurring is not visible. Fast moving objects, such as a football in flight, gives slight blurring. The worst blurring occurs when the camera viewing the original scene is panned fairly fast, e.g. at a football match. Then the blurring is disturbing. However if there is a principal item of interest in the center of the picture which the cameraman keeps centered, such as a racehorse galloping, the blurring, which occurs on the surrounding scenery, is much less noticeable.

Fig. 6. Photograph of output waveform of converter with a linear sawtooth applied to the input.

It is perhaps of interest to note that a strict geometrical lineup procedure is required when setting the converter in action. The image orthicon is prone to scan burning on the target so that the correct part of the target must be scanned exactly on each occasion so that burns do not appear in the picture.

It is necessary therefore, that the display image must be corrrect in size and position with respect to the optics of the pickup camera.

For alignment it is arranged that a glass test pattern of the precise aspect ratio is held on the display tube face in a gate of the exact overall dimensions of the scanned patch (Fig. 7).

The camera scans are adjusted to fit this aperture. When the image focus and magnification are correctly adjusted, the test slide is now removed and the display scans adjusted also to fit the aperture precisely, the camera being switched to the overscan position so that these edges can be clearly seen.

An incidental gain of this accurate alignment is that picture information at the edge of the pictures is not lost.

Signal Shaping and Correction

The standards converter at Dover is the last terminal in a long chain of links across Europe. These links are not engineered as complete transcontinental circuits such as exist in America, but comprise a number of separate component links belonging to the various administrations connected together as occasion requires. For example, a program originating in Holland and destined for England must pass over Dutch, Belgian and French links before arriving at Dover.

With such arrangements it is not entirely surprising that distortion of the signal should occur and at times reach appreciable proportions. As experience has been gained and new equipment introduced these distortions

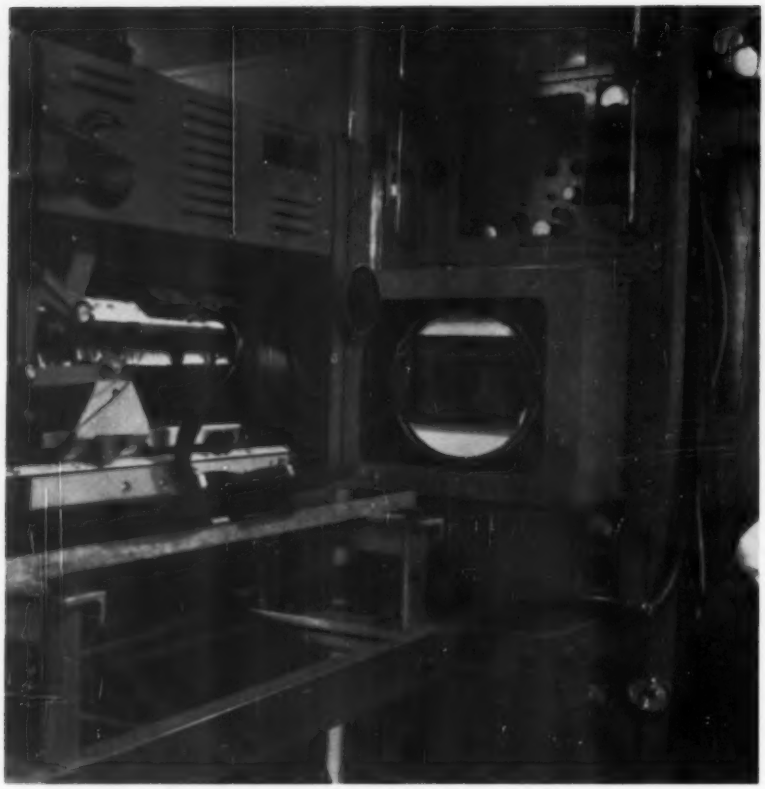

Fig. 7. The camera and display tube, showing alignment slide in place (light exclusion hood removed).

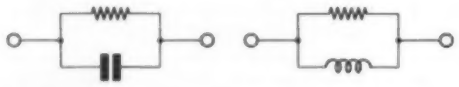

Fig. 8. Configuration of basic low- and middle-frequency equalizer.

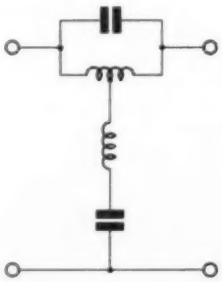

Fig. 9. Configuration of phase equalizer section.

have been considerably reduced but it is still found profitable to operate on the received signal at Dover, to obtain the best possible picture before presenting it to the converter.

The major distortion encountered nowadays, is an incorrect amplitude-frequency characteristic, though in the early days amplitude nonlinearity was also a major problem.

The deficiencies of the amplitude-frequency characteristic with the accompanying phase distortion are usually in the region of low to middle frequencies (100–500 kc). As is well known, a small error (0.25 db step between low and high frequencies) causes a visible degradation of the picture a step down, in particular, causing the characteristic mistiness so often encountered in maladjusted television receivers.

These distortions of course vary in magnitude depending on the particular links in use and so a number of variable equalizers are incorporated in the terminal apparatus to give the necessary correction. These equalizers consist of several sections of the basic configurations, as in Fig. 8, at various half-loss frequencies between 100 and 500 kc and whose loss can be varied from 0 to 1.25 db in 0.25-db steps. The particular design of equalizer is based on Bode[3] whereby the basic loss of a section can be varied without changing the half-loss frequency. Prior to the transmission, a number of test signals are sent from the program originating country so that the correct equalizer setting can be found. The criterion for correct middle-frequency response is the optimum shape of rectangular pulses at line speed.

There is also sometimes need to correct for top loss but nowadays a drop of more than 6 db at the top end of the band is seldom encountered. This is compensated by a conventional passive equalizer with a variable loss.

Finally, a variable phase compensating

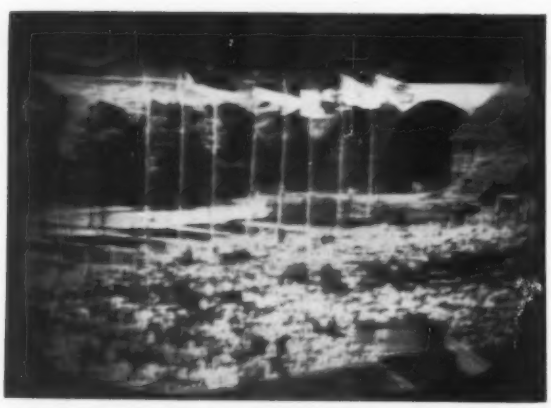

Fig. 10. Example of incoming picture suffering from bad middle- and low-frequency distortion.

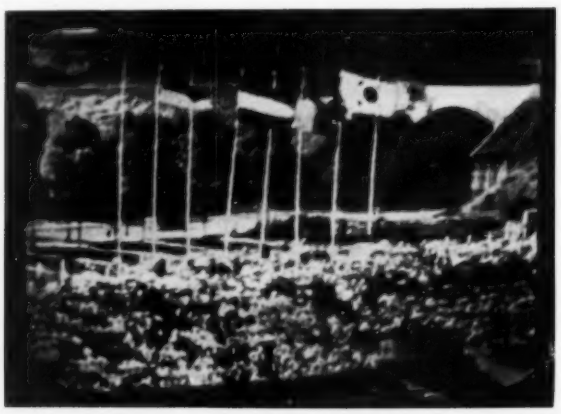

Fig. 11. The same picture as Fig. 10, but after equalization and conversion.

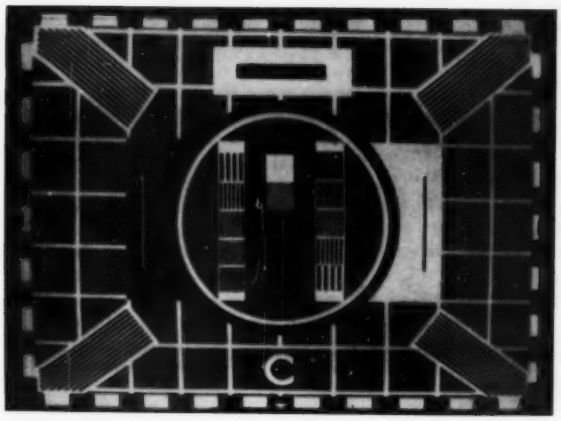

Fig. 12. Example of conversion of test pattern 405–625 lines, input signal.

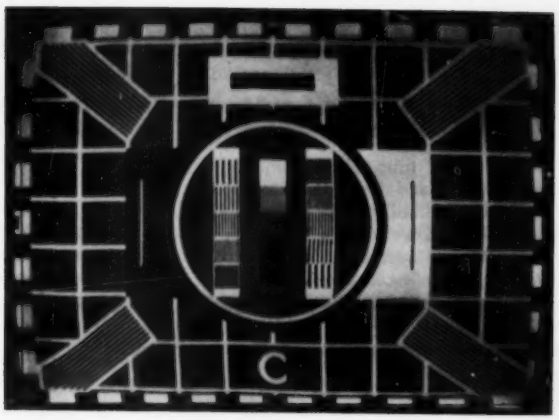

Fig. 13. Example of conversion of test pattern 405–625 lines, output signal.

network consisting of several sections of the configuration shown in Fig. 9 gives the optimum response on sharp edges.

All these adjustments require skill and experience, but if these hard won commodities are applied a very considerable improvement of picture quality can be obtained. Figures 10 and 11 show an extreme example of a very bad incoming picture and the result after correction and standards conversion. Figures 12 and 13 show an example of conversion of a test pattern.

Acknowledgments

The author is indebted to the Director of Engineering of the B.B.C. for permission to publish this paper.

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Video Time-Delay Systems for International Television Program Exchange

By ROSS H. SNYDER

The line and field rate standards of one country have often to be converted to different standards of another country in exchanging TV programs. In the course of video-tape recording research, certain techniques have been developed for storing various intervals of TV information. The possibilities for conversion between standards for time-delay distribution are outlined.

EXCHANGING OF timely television programs at convenient local hours among the nations of western Europe is complicated chiefly by the need for conversions of frame and line standards from country to country. Exchanging programs between more distant areas requires not only frame and line conversion but also time delay, usually for periods of 12 hours or less. Western European countries generally share the same clock time, but clock time in the United States differs from European clock time by four to eight hours. Even greater time differences separate the United States from Asia.

Presented on October 23, 1958, at the Society's Convention at Detroit by Ross H. Snyder, Ampex Corp., 934 Charter St., Redwood City, Calif. (This paper was received on February 3, 1959.)

Video recording on magnetic tape seems well suited to meet the above requirements. Magnetic recorders for all four basic TV standards are now in existence. Thus, the means are immediately at hand to overcome clock time differences for the international exchange of TV programs.

Only four different systems exist so far as the delay system is involved today, despite numerous local variations in transmitter outputs. Differences in the separation of broadcast sound carrier from television carrier, differences in the type of modulation of sound carriers, and differences in the allocation of nominal center-channel frequencies will not affect the delay system. A satisfactory input for any television transmitter in the world can be found among the four basic systems which are:

	Lines/frame	*Frames/sec*
U.S.	525	30
British	405	25
Continental	625	25
French	819	25

In Canada, Mexico and Japan the system is the same as that of the U.S. The 625-line system is used throughout most of Europe, Australia and some of South America; it is also standard in eastern Europe and U.S.S.R. The 819-line French system is confined to France, parts of countries bordering France, the Benelux countries and France outremer.

More than 200 recorders are now in use on the 525-line, 60-field system in the U.S., Hawaii, Canada, Mexico and Cuba, and including 25 in Japan. There are 16 such recorders in use in the United Kingdom today, operating on the 405-line system. Eight, operating on the 625-line standard, are now located in West Germany, although some of these are

destined for other parts of continental Europe. A 625-line recorder is now in service in Australia. Design of a recorder for the 819-line system for France has been completed.

Tape is well suited to solution of the international time-delay problem. It is re-usable, and therefore economical. Since we are aiming at large-scale international exchange of television programs, economy of operation is important. Perhaps more important is the ability of magnetic tape to reproduce substantially the same picture which is fed into it. The picture is already subject to more or less degradation, in the line and frame conversion process — least degradation in going from a very finely structured picture, like the 819-line French one, to a relatively coarse system like the American or the British, and most in going from a comparatively coarse system to one of the finer systems. These will be degradations in resolution, and distortions of fast action. We should surely avoid adding to these also the degradations which are inherent in fast photographic delay methods. These would include distortion of the gray scale, which is most serious, and further degradation of horizontal resolution, due to difficulties in scanning the photographically recorded line structure. For these reasons magnetic TV tape seems to offer the best hope of minimizing degradation in the delay systems we must use.

The matter of superior gray scale transfer in tape can bear further emphasis. Experience now indicates quality of gray-scale transfer is the largest single factor which distinguishes live television from less immediate programs, in the eyes of viewers. The impression of immediacy will surely be highly desirable in international television exchange.

Altering the 525-line Recorder

Beginning with the U.S. 525-line 60-field recorder, the difficulty in making recorders for other systems lay not so much in line-rate as in field-rate. Yet the alterations in the recorder are not extensive, particularly for conversion of the U.S. recorder to the 405-line system; the 625-line and especially the 819-line systems offered greater difficulties. In the Ampex system, a rotating head, bearing four individual record and reproduce heads, traces laterally, at high speed, tape which is passing at a velocity of 15 in./sec.

This head revolves at 14,400 rpm, or 240 rps, a rotational rate chosen because it is an integral multiple of the 60-field rate. Thus, there is immediately open the possibility of using a 250-rps (15,000-rpm) system. This is a small percentage change in the rotational rate and in practice quite attainable. This rate is an integral multiple of 50 fields. In the U.S. system, tracks are ten mils wide, with an intertrack separation of $5\frac{2}{3}$ mils. When we increase the speed of rotation of the head from 14,400 to 15,000 rpm, only a minute change in the recorded structure is implied. We still record a track ten mils wide, in order to maintain uniformity of manufacture in the width of the recording head, but the intertrack separation is reduced to five mils. This is not a significant matter in the performance of the system. An integral multiple of the field rate is used as drum rotational rate so as to obtain an integral number of lines of recording on each track, and an integral number of tracks per field. Changing only the rotational rate of the drum thus produces a system capable of accommodating the 50-field changeover.

The uppermost frequency of effective response, for the U.S. recorder, is 4 mc. It has been deliberately set at that point to achieve good balance between resolution and signal-to-noise ratio. It could be made higher if it were desirable to do so. However, the British system requires only a 3-mc bandpass to service receivers with the maximum of information which they normally can reproduce. In a 405-line recorder, the bandpass is narrowed slightly, with a small improvement in signal-to-noise ratio. The nominally assigned upper band limit with the 625-line system is 5 mc in some countries, 6 mc in others. It has proved optimum to set the uppermost frequency response of the recorder not at the 6-mc point, which would more fully exploit the resolution capabilities of the system, but instead at 5 mc, again because this turns out to be the better compromise between resolution and signal-to-noise ratio. The 819-line system needs a 10-mc channel. This is beyond the capabilities of head structures as they now exist, in the Videotape* Recorder. An uppermost frequency response of somewhat under 6 mc gives resolution superior to that obtained previously in France by fast photographic methods, and equal to many long-distance live transmissions there.

The 819-line system presents an additional problem in its 20,475-cycle horizontal line rate. Achieving clean synchronization at this rate required an increase in the rotational rate of the drum to 300 rps (18,000 rpm), and a further narrowing of the intertrack separation. This yields a head-to-tape writing speed of almost 1900 in./sec.

The entire conversion, for any of the four systems, is accomplished by alteration of electrical components only. The relative motion of heads and tape in the Ampex Videotape* Recorder is determined by an electroservomechanism, which has the ability to respond over a larger range than U.S. standard service requires. Therefore we can replace electronic L,C and R components in the drum servo and in the servo generator, and accomplish almost all of the changes which are required.

But we should not anticipate a single recorder, with a multiple-position switch, capable of recording any of the four systems at the touch of a button, because a very large number of individual components are involved. One of four different recorders in one center could receive any system, and that recorder feed out again substantially what it received, with any degree of time delay that might be desired.

We do, however, now have at hand means for rectifying clock time for international exchange of programs, as and when they are needed. Engineering design of international standard versions of the Ampex Videotape* Recorder was carried on under the direction of Kurt Machein, to whom we are indebted for the information here reported.

Discussion

George Lewin (Army Pictorial Center): In view of the obvious complications that are introduced because of different standards as indicated in both this paper and the preceding paper (by T. Worswick), is there any movement on foot to have an international standard of lines and frames?

Mr. Snyder: I doubt that even the U.S. State Department or the CCIR (Comité Consultative International Radio) could answer that. Certainly many movements have been undertaken in this direction, but they seem to have had no success. We would surely be asking for the confiscation of large amounts of receiving equipment now in the hands of a lot of consumers, whose permission is not likely to be forthcoming.

* Trademark, Ampex Corp.

A Flying-Spot Film Scanner for Color Television

ABRIDGMENT

By H. E. HOLMAN,
G. C. NEWTON and S. F. QUINN
(*Abridged by Pierre Mertz*)

Film moving with uniform velocity is scanned by a series of displaced rasters in such sequence that the system is applicable to 50- or 60-cycles/sec conditions. Three photomultipliers provide color analysis of the image, element by element, and directly produce a video-frequency signal. A particular equipment is described. The choice of Red, Green, Blue (RGB) coordinates is examined, and arrangements are discussed to minimize color flicker, to provide uniform field illumination and to offer the most accurate picture reproduction.

THE GENERATION of television signals from motion-picture film may be accomplished by three main methods:

(*a*) An intermittent film projector with a television camera;

(*b*) A mechanism where the continuous motion of film is optically compensated and which is employed either with camera or flying-spot analysis;

(*c*) A continuous-motion flying-spot scanner using electronic compensation of the film movement.

This paper is concerned with group (*c*).[1,2,3]

The Flying-Spot Color System

The scanning spot is presented as a white raster upon the face of a cathode-ray tube and an objective produces an image of this spot upon the film where components of white light are absorbed and the remaining colored light is transmitted. A condenser directs this colored component through a beam splitter where the light is apportioned in terms of the chosen primaries to three photomultipliers (Fig. 4).*

The apparatus may be used initially in a monochrome version to which color facilities may later be added without structural change.

Immobilization of Film Motion

The sequence of patch positions to suit European conditions of 50 fields/sec (interlaced) with a film speed of 25 frames/sec is shown in Fig. 2, while Fig. 3 demonstrates the case of a 60-c (cycles-per-second) system which uses a film speed of 24 frames/sec.

There are several essential requirements to produce results of the highest quality. First, field pulses must occur at strictly uniform intervals and rigorously in synchronism with the film, whose velocity must remain constant at the rate of $\frac{1}{2}$ (alternatively $\frac{2}{5}$) frames/field exactly. Also, any particular part of a film frame must be presented to the corresponding points in two successive scans at precisely the interval of field frequency. In addition, the general geometrical characteristics of the patch must be maintained irrespective of its position upon the tube face. In extreme positions, it is required to maintain interlace between the top corners of a patch generated wholly in the upper half of the tube face, with corresponding parts when the patch is generated substantially in the lower half.

Not the least of the major development problems have been concerned with the design and construction of the film transport, scanning coils and circuits necessary to maintain the desired accuracy of picture immobilization.

Optical Arrangement of the Scanners

An image of the raster is formed at the 16mm gate by a lens of $2\frac{1}{2}$-in. focus working at × 9.0 magnification, while for the 35mm machine a lens of 4-in. focus is used at × 4.2 magnification, the initial object size being unaltered. These specially computed lenses have an aperture of $f/2.0$. The beam splitter consists of two dichroic reflectors and its effect must be analyzed in conjunction with the characteristics of the condenser because, during film passage through the projector gate, light reaches the photocathode by a number of different paths. Over successive fields these show variations in angle of incidence to the dichroic reflectors amounting to some ±15°. The optical path length through a layer, and hence the spectral characteristic of the dichroic, depends upon the angle of incidence, so that the transmission at different scan positions gives rise to different luminance values which result in color flicker. This condition is corrected by "Color tilt" controls which separately vary the gains of the photomultiplier tubes with a line sawtooth.[14]

Scanning System with Automatic Control of Scanning-Tube Brightness

As shown in Fig. 2, the resultant scanning waveform in 50-c television systems derives from 50-c sawtooth and 25-c shift components, while Fig. 3 demonstrates that, in the case of 60-c systems, the waveform is a combination of 60-c sawtooth and 12-c shift.

Abridgment by Pierre Mertz of a paper in *Proc. of Institution of Electrical Engineers: Pt. B, 105:* 317–330, July 1958.

*Figures 1, 5–9, 12, 16, 17, 19 and 20 are omitted.

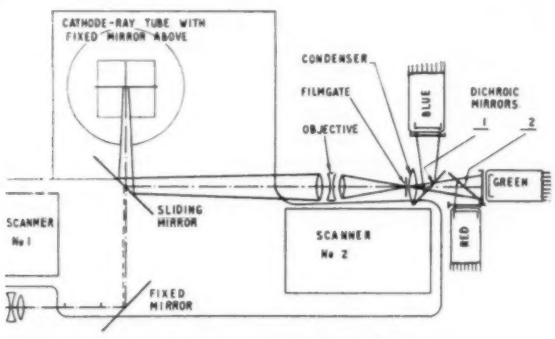

Fig. 4. Arrangement of scanners and optical system.

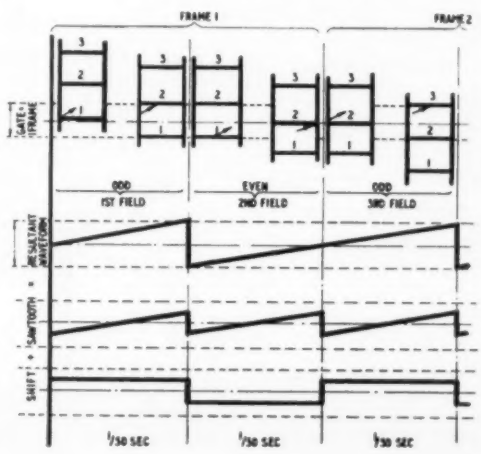

Fig. 2. 50-c scanning sequence.

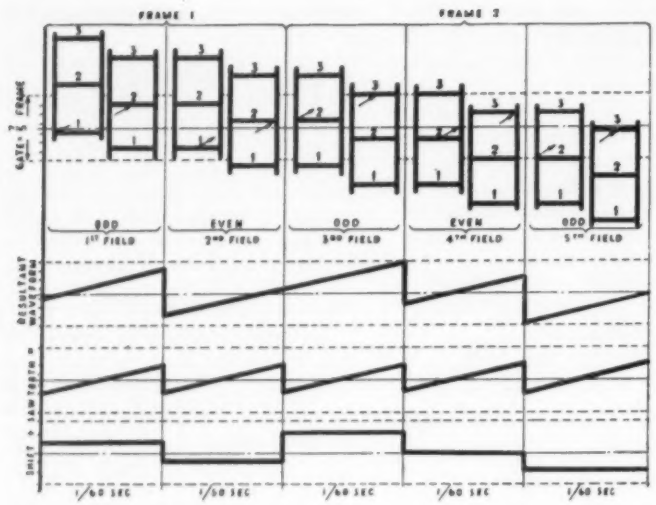

Fig. 3. 60-c scanning sequence.

Errors in sawtooth waveforms for line and field affect every patch in the same way, but in the case of the shift waveform, any error would be manifest by a loss of interlace. Shift waveforms must therefore be stable to within half a line spacing, which, for a 625-line system, requires an accuracy of 1 part in 1200.

In the 50-c system, the shift component is a simple 25-c square wave. Uncertainty in patch synchronization is avoided by generating a phasing pulse at the motor-drive unit every second film frame (four television fields), and using it to trigger the 25-c square wave.

With the 60-c system, an interlocked 12-c shift waveform is required, and this is provided by five relays which operate in a regular sequence selecting potentials from a high stability resistance bleed from +300 v to ground. Again uncertainty in patch synchronization is avoided by generating a phasing pulse at the motor drive unit every second film frame (five television fields), and using it to trigger the sequence of relays.

The brightness of a scanning tube with fixed beam current varies over the raster because spot size, and therefore current density at the phosphor screen, is not constant. Hence a photomultiplier tube is arranged to measure the brightness at every point of the raster and pass an error signal to the grid of the scanning tube. A 3-stage wide-band amplifier permits reduction of brightness variations by 15 db.

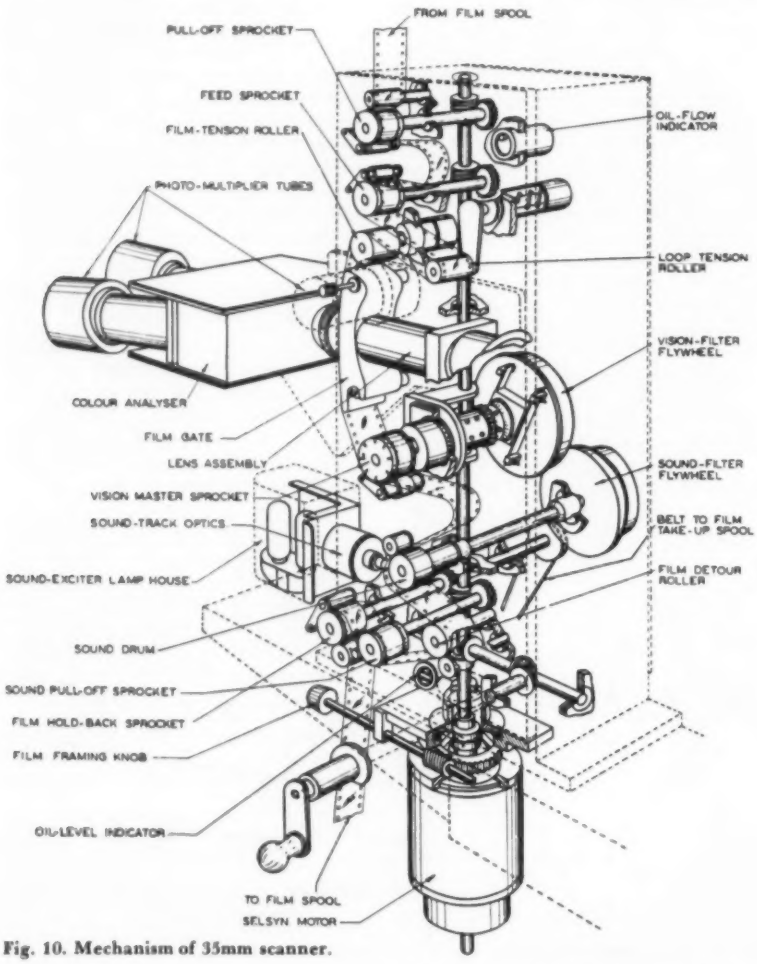

Fig. 10. Mechanism of 35mm scanner.

Film Traction

The 16mm and 35mm machines are very similar except for the size of sprockets and layout of spindles, but they share the common requirement that the film speed through the scanning zone must be maintained to within very close limits. For vertical stability of a quarter line with a 625-line system, errors in instantaneous position for 35mm film must not exceed 0.0003 in., and in the case of 16mm film, 0.00012 in. This is particularly severe for 16mm film, located by only one perforation per frame, and yet submitted to magnification 2.15 times greater than 35mm film, which has eight perforations.

For this reason the gearing in this machine is limited to one stage per function (Fig. 10), and since the speed reduction between driving motor and film sprockets is considerable, worm gearing has been used throughout. Further refinement is obtained by providing, between wormwheel and master-sprocket spindle, a mechanical low-pass filter, consisting of a spring-connected Duralumin drum, inside which is concentrically mounted a freely rotating, heavy flywheel. The small clearance space between drum and flywheel is filled with viscous oil.

When a number of picture and sound sources is in use, each auxiliary driving motor must be synchronized with television field pulses and independent of the mains supply frequency; this allows film to be inserted into program derived from another source, even though there may be a frequency difference up to ±2 c. For this purpose, the main generator driving motor has its stator winding connected to the station mains

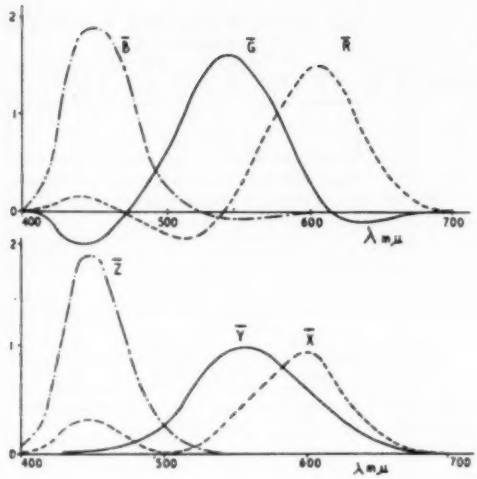

Fig. 11. RGB and XYZ distribution coefficients.

supply, while the rotor is fed from a separate source controlled by the television field pulses. Correct film speed is obtained at supply frequencies of either 50 or 60 c, by using appropriate gearing and there is a contact-maker in this drive which provides the timing pulse to maintain synchronism of the patch movement with film motion, as explained above.

Color Analysis

Choice of Coordinates

Important considerations when adopting basic color coordinates for a system are:

(*a*) fidelity of color reproduction,
(*b*) signal to noise ratio in the luminance signal, and
(*c*) efficient use of light.

These features are discussed in relation to two possible systems of analyzing coordinates (Fig. 11) which are:

(*i*) The NTSC primary colors, RGB, and
(*ii*) The CIE primary colors, XYZ.

Color Fidelity

The color analysis becomes inaccurate with the RGB coordinates if only three photomultipliers are used, because negative lobes of the curves are neglected. Indeed, with some color samples, an error about six times greater than that photometrically just perceptible, is exhibited.

An alternative is to use XYZ coordinates which provide more accurate analysis but require conversion to RGB signals by matrix circuits.

Signal-to-Noise Ratio

In the RGB system, the rms noise voltage remains nearly the same for white as for colors, apart from the most saturated ones.

In the XYZ system, matrices are required to obtain RGB signals before gamma correction. For any color, the derived RGB signals are applied to different points of the gamma curve in each color lane, and the noise voltages are modified in different ways. The output signal for any color (and also the noise) contains components of X and Z signals. Thus a red field, for example, may have as much as 20 db more noise than a white one. The rms noise voltages for different colors in both systems are shown in Figs. 13 (a) and 13 (b).

Utilization of Light

The spectrum of the zinc-oxide phosphor used in the scanning tube is plotted in Fig. 14, which also shows those particular spectral characteristics which led to the choice of photomultiplier tubes. Type 6097, antimony-caesium, is best suited to B, Z and G, while 6295, silver-bismuth, is used for Y, R and X.

Since the more sensitive photomultiplier endows the G signal with at least 3 db less noise than the Y signal, and since the spectral sensitivities overlap less, the use of RGB coordinates is more efficient.

The Choice Between RGB and XYZ Systems

The signal-to-noise ratio in the luminance signal in RGB coordinates is

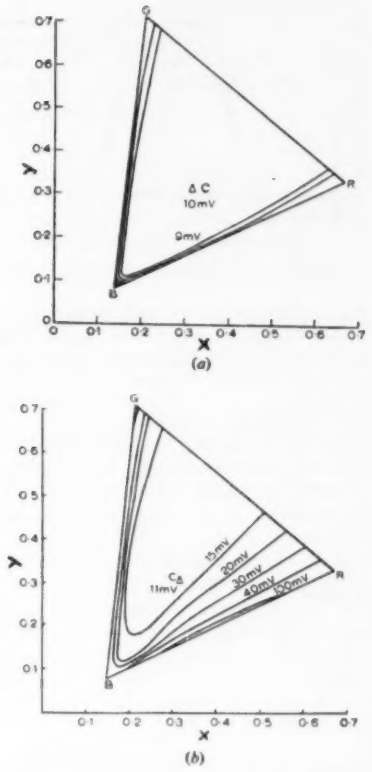

Fig. 13. Rms noise (in mv) for 1-v (peak) V'_Y signal.

Δ Illuminant C

(a) Using RGB coordinates. Rms noise in RGB signals is

R = B = 50 mv
G = 25 mv

(b) Using XYZ coordinates. Rms noise in XYZ signals before matrix to RGB is

Z and X = 50 mv
Y = 25 mv

preferable to that in XYZ. The RGB system also offers an increase in light efficiency besides avoiding the use of matrix circuits. It was for these reasons that the RGB system was chosen.

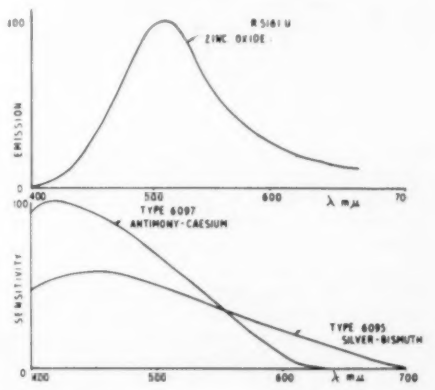

Fig. 14. Spectral characteristics of phosphor and photolayers.

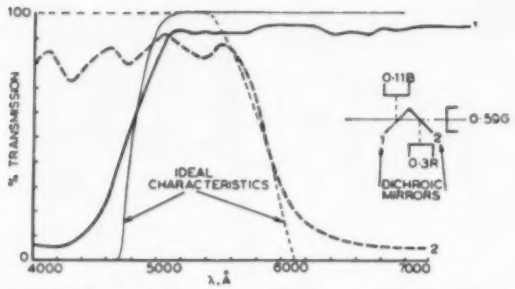

Fig. 15. Beam-splitter characteristics. Dichroic mirror 1: ——— ideal curve; ——— curve obtained. Dichroic mirror 2: - - - - - ideal curve; — — — curve obtained.

Beam Splitter

Referring to Fig. 4, if the reflection R_1 from dichroic mirror 1 is $\bar{b}$, the transmission T_1 of the same mirror is $(1 - \bar{b})$
and

$$T_1 R_2 = \bar{r}$$

so that

$$R_2 = \frac{\bar{r}}{1 - \bar{b}}$$

and

$$T_2 = 1 - \frac{\bar{r}}{1 - \bar{b}} = \frac{\bar{g}}{1 - \bar{b}}$$

Figure 15 shows transmission curves for mirrors 1 and 2, comparing the ideal requirements with the practical results achieved.

The products of the spectral characteristics of all the elements in the color lanes should produce the required distribution coefficients $\bar{R}$, $\bar{G}$, and $\bar{B}$, respectively (Fig. 11). For final adjustment correcting filters made from calculated sectors of colored gelatin are inserted close to the face of the photomultipliers.

Video-Frequency Signals

RGB Signals

Each projector has its own color picture head, giving output signals approximately proportional to the incident colors. The RGB signals at this point are 18 mv (peak) color with the black level at zero (Fig. 18). Corrections for afterglow of the scanning tube are made here before amplification and the gamma correction is applied separately in each lane. This can be varied to adjust the contrast range of the RGB color signals to suit the color display, and a color-mask unit may be inserted at this point. Control of hue and saturation of the reproduced colors is offered to provide a more pleasing effect, or to correct for shortcomings in the rendering of some types of color film.

Color Modulator

The color modulator accepts the output RGB signals and produces a composite signal which may be for the 525-line 60 field/sec, 405-line 50 field/sec or 625-line 50 field/sec television systems, respectively. Variable-aperture correction is applied to the luminance channel (Y) only; this compensates for loss of high-frequency response due to the scanning tube and optical components, and there is available a maximum of 9 db boost at 5 mc. Synchronizing pulses are added to the Y signal, and the bandwidths of the two color difference signals, I and Q, are appropriately limited. One set of YIQ signals is then available for connection to a local color monitor, and the composite color signal is produced from a second set with an externally generated color subcarrier.

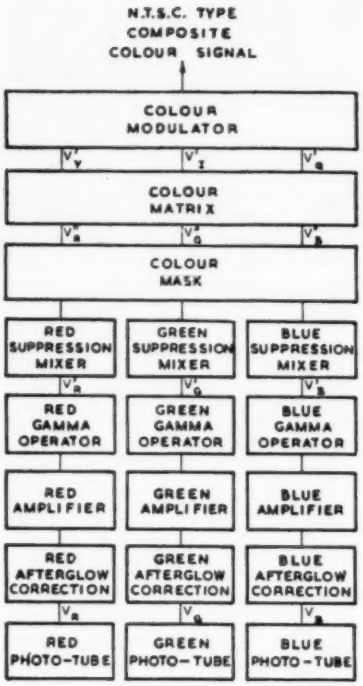

Fig. 18. Video-frequency block schematic.

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The Projection of Color Television Pictures

ABRIDGMENT

By T. POORTER
and F. W. de VRIJER
(*Abridged by Pierre Mertz*)

A projection system for monochrome television was developed in the Philips Eindhoven Laboratory more than 10 years ago. Further work resulted in the development of apparatus for the projection of colored television pictures onto a screen. Projectors have been built giving pictures 22 cm by 29 cm and 35 cm by 46 cm at m highlight luminance of 200 candles/sq m (63 mL), and 2.25 m by 3 m at a highlight luminance of 20 candles/sq m (6.3 mL). The projectors were demonstrated before the Color Television Commission of the CCIR in 1955 and 1956.

A SET OF THREE projectors, one for each of the three primary colors, is taken as the basis of the system. The projectors can be designed on exactly the same lines as those for monochrome television. Such a projector, embodying the Schmidt optical system, was described in the literature in 1948.[2,3]

In theory, superposition errors are absent if the projectors are placed in such a way that the three images are projected from one point. Figure 2* shows how this may be done with two dichroic mirrors.[5] Mirror *r* reflects red and passes green and blue; *b* reflects blue and passes red and green. Green light goes through both mirrors, the proportion transmitted being between 70% and 80%.

With this layout, color variations over the picture area arise because the light beams of one color do not all strike the mirrors at the same angle. When the line of mirror intersection is horizontal, the angle variation is less than when it is vertical. This is because picture height is less than its width. However it makes the apparatus height taller, a disadvantage if the projector, because of short throw, is located in front of the viewers.

Designs embodying dichroic mirrors have disadvantages. The first is a loss of brightness and contrast, due to the number of reflecting and absorbing surfaces in the beam paths, especially if these are "folded." The second is a loss of sharpness due to difficulty in achieving a completely stress-free mirror mounting.

Thus, arrangements have been sought whereby the three primary-color images are *not* projected effectively from the same point. This gives superposition errors, and some compensation of these must be sought.

Figure 5a illustrates such an arrangement. The outside projectors are pointed inwards and their optical axes intersect in the center of the screen. The vertical center lines of the separate images coincide (*MM'* in Fig. 5b). But the magnifications are not equal in the right and left picture halves. By an electrical correction in both line and field scanning of the outside tubes the three images can be made to coincide.

The line scanning waveform must be curved to increase horizontal velocity on the near half of the picture and diminish it on the far half. From Fig. 5b it will be clear that the field scan for the blue has to be shortened on the left and lengthened on the right, in the rhythm of the line frequency. The correction current therefore has the shape drawn in Fig. 8a. It might be obtained by multiplying a sawtooth of field frequency (Fig. 8b) by a sawtooth of line frequency (Fig. 8c);

Abridgment by Pierre Mertz of a paper in *Philips Technical Review, 19, No. 12:* 338–355, published Aug. 22, 1958.
*Figures 1, 3, 4, 6, 7, 9–16, 18, 19, and 21 are omitted.

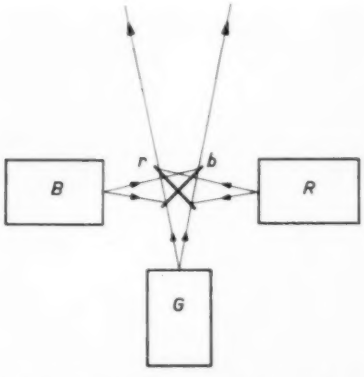

Fig. 2. Superposition of three primary-color images by means of crossed dichroic mirrors (r and b). Mirror r reflects the red light from R and passes the green from projector G and the blue from projector B. Mirror b reflects blue light and passes red and green.

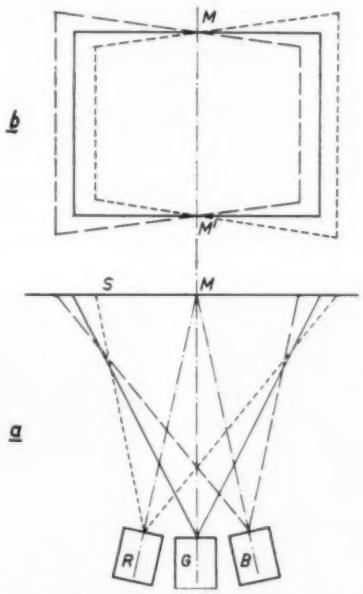

Fig. 5a. Arrangement whereby the three primary-color projectors, R, G and B, are placed side by side, with the two outer ones inclined inwards at an angle such that the vertical lines through the centers of the three images (MM' in diagram b) coincide.

Fig. 5b. Trapezium distortion of red and blue images caused by arrangement in Fig. 5a.

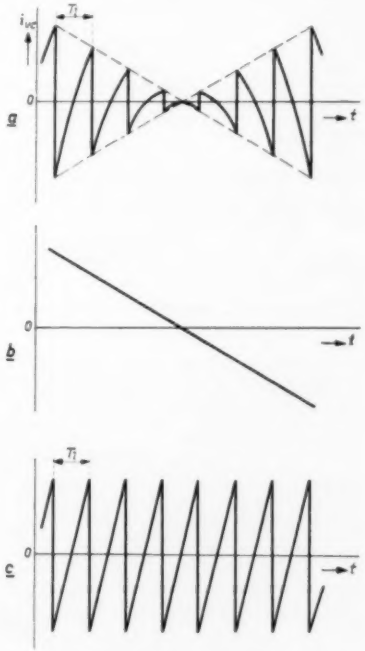

Fig. 8. Trapezium correction. (a) Waveform of correction current i_{vc} added to field scanning current of righthand projector (B in Fig. 5a); lefthand projector requires correction with a current of the same magnitude but of opposite sense. T_1 is the line period. The function in diagram (a) is the product of the sawtooth (b) of field frequency, and the sawtooth (c) of line frequency.

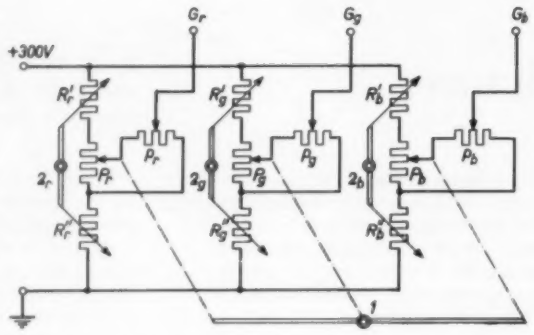

Fig. 17. Schematic diagram of the proportional brightness control. Bias voltages for the red, green and blue cathode-ray tubes are derived from points G_r, G_g and G_b. Knob 1 adjusts the general brightness level via ganged potentiometers P_r, P_g and P_b. Knobs 2_r, 2_g and 2_b are for adjusting the brightness of the red, green and blue images separately. The potentiometers p_r, p_g and p_b are for obtaining the right proportions between the brightness values of the three images.

but in practice it is obtained by the addition and subtraction of waves rather than by multiplying.

Dimensions of optical systems and projector tubes are determined by requirements on projected picture size and peak luminance, and phosphor luminous efficiencies. Phosphors having color points near the ones used in the NTSC (U.S.) system and luminous efficiencies in lumens/watt are listed in Table I.

Table I. Data on Phosphors Used.

Primary color	Composition of phosphor	Coordinates of the color point x	y	Luminous efficiency lm/w
Red	$(Zn, Be)_2SiO_4$-Mn (with Wratten filter 25)	0.670	0.330	$\eta_r = 2.5$
Green	Zn_2SiO_4-Mn	0.195	0.720	$\eta_g = 21$
Blue	$(Ca, Mg)SiO_3$-Ti	0.160	0.125	$\eta_b = 2.5$

To obtain illuminant C, the luminances of the primaries have to be in the proportions:

$$L_r : L_g : L_b = 29 : 51 : 20$$

Projection-tube screen dissipations must be in the proportions:

$$P_r : P_g : P_b = L_r/\eta_r : L_g/\eta_g : L_b/\eta_b = 53 : 11 : 36$$

The red tube screen has to dissipate the highest power. For a highlight luminance L_{max}, this is $L_{r\,max} = 0.29\,L_{max}$.

For a given magnification, the focal length has to be increased in direct proportion to the throw, and so also do all other principal dimensions of the optical system. The throw should therefore be kept as short as possible — this is why the apparatus is set up in front of the viewers. However, there is also a lower limit since, as the subtended picture angle increases, optical aberrations and fall-off in brightness to the picture edge increase.

An illustrative design study is outlined. A projected picture 2.25 by 3 m having a maximum luminance of 20 candles/sq m (6.3 mL) is assumed. A maximum power of 4000 w, it is assumed, can be dissipated per square meter of tube screen. The maximum red flux is 59 lm; dissipated power on red screen is 24 w; tube image size, 6.7 by 9 cm.; throw, 5.6 m; diameter of Schmidt corrector plate, 24 cm.

Where dichroic and "folding" mirrors are used picture highlight luminance will be reduced by roughly 50%. Where, without these, highlight luminances of 20 candles/sq m (6.3 mL) are obtained, with them 10 candles/sq m or 3.1 mL are obtained.

Table II gives dimensions of four equipments built in the Philips laboratory. The first corresponds roughly to the illustrative example.

Vignetting is important in the design, and the endeavor must be to keep it the

Table II. Data on Schmidt Optical Systems.

	1	2	3	4
Dichroic mirrors	no	yes	yes	yes
Type of system	in-line	folded	folded	folded
Picture on projection screen:				
Height	2.25†	2.25†	35‡	22‡
Breadth	3.00†	3.00†	46‡	29‡
Max. luminance (candles/sq m)	20	10	200	200
Contrast ratio	35	25	25	25
Definition*	600	425	450	500
Screen "gain"	2.8	2.8	7	7
Tube screen diam., cm	13	13	6	6
Concave mirror curvature radius, cm	40	40	20	20
Focal length, cm	20.8	20.8	10.4	10.4
Corrector plate diam., cm	28	25	12.5	12.5
Throw	6†	6†	82.5‡	64.5‡
Magnification	31	31	9.2	7.4

* Number of lines; determined with an RMA test plate.
† m
‡ cm

Fig. 20. Large-picture projection set with cover removed. The Schmidt optical systems, which are of the "in-line" type, are mounted side by side.

Fig. 22. The projector of Fig. 20 in its housing. The picture size is 2.25 m by 3 m ($7\frac{1}{2}$ ft by 10 ft) and the maximum luminance 20 candles/sq m.

same to the left and right from the three tubes to avoid local color variations.

A scanning unit should deflect the electron beam in two directions separated by an angle of exactly 90°. Slight deviation is unnoticeable in monochrome television. For color, deviations are troublesome where they differ among the three images. Either scanning units must be built with care, or correction currents must be injected into the sweep waves.

In the alignment for exact registration of the three color images, the tube images are moved into as nearly central a position as possible on the phosphor screens by turning the focusing coils. The three projected images are then made to coincide by mechanically aligning the projectors.

The circuit employed for brightness control is shown in Fig. 17. Separate brightness controls, *2*, serve to compensate differences in projection-tube cutoff voltages. Here, total resistance, $R_r' + R_r''$, remains constant, and the same holds true for green and blue. Proportionality controls *p* compensate differences in slope. Knob *1* controls overall brightness without any change of neutral tint on the projection screen.

Each of the three projection tubes has its own video amplifier. Special linearity requirements arise from their influence on the color rendering of the final picture. The nonlinearity is used to compensate for differences in saturation of the phosphors. The saturation is greatest for the red phosphor. Thus, if gray shades are correct in both lightest and darkest parts of the picture, the intermediate shades, without the nonlinear compensation, will be too red.

A number of color television projectors have been built in the Philips Eindhoven Laboratory (Table II). The smaller ones (3 and 4) use experimental projection tubes similar to the MW 6-2 monochrome[9] (screen diameter 6 cm, anode voltage 25 kv). The light falls on a transmission projection screen of polyvinyl chloride, having grooves on front and back faces to give the desired directional characteristic.

Equipment for larger pictures (1 and 2) uses tubes with 13-cm screen diameter and 50-kv anode voltage. Of the two, the apparatus free of dichroic and folding mirrors (Figs. 20 and 22) gives considerably better optical performance.

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The Historical Motion-Picture Collections at George Eastman House

By JAMES CARD

Opened in 1949 as a museum of photography and cinematography, George Eastman House contains a priceless collection of motion-picture apparatus and a library of more than seven million feet of film which is stored in specially constructed vaults. Some of its rare and historically significant cameras and projectors are described.

THE EXTENSIVE historical collections of photographic apparatus, photographs, motion-picture equipment and motion-picture films of the George Eastman House of Photography in Rochester, N.Y., are preserved in the stately mansion which George Eastman built for his own home in 1905.

Opened in 1949 as a public educational institute, the George Eastman House now serves as a living and lasting memorial to the man who brought photography to all.

The main building is used for the presentation of the historic collection of photography. The large garage and stable building has been converted for the display of contemporary photography and the manufacturing of photographic materials. Between these buildings, and joining them, a 550-seat theater has been erected with a special exhibition gallery on its second floor. Motion pictures from the collection are shown to audiences every week end and three nights during the week.

The George Eastman House came into being as an educational institution through the generosity of the University of Rochester. The University donated the building, which it had inherited from George Eastman, and the Eastman Kodak Co. supplied funds for the transformation of the building into a public museum and for its maintenance. The House is independently administered by a Board of Trustees and is chartered by the University of the State of New York as an educational institution.

The motion-picture study collection was begun in 1950 and is designed to enable students to:

(1) examine each film which constitutes a major development in technique or style of film-making;

(2) observe the manner in which changing social problems affected the motion picture and how they were in turn affected by the public's reaction to popular films;

(3) trace the growth or decline in the work of leading motion-picture artists;

(4) learn the major steps in the development and use of motion pictures, specialized in their purposes;

(5) refer to newsreels and documentaries as source material in the study of specific events, or to obtain authentic details of dress and architecture; and

(6) compare the several versions of identical stories many of which have been repeated at intervals spanning most of the history of motion pictures.

These objectives have been pursued through the operation of various programs.

Films in the study collection are shown on request and without charge to anyone having a specific and serious interest in any phase of motion-picture history.

A group of the films selected by area educators is shown on the premises

Presented on April 21, 1958, at the Society's Convention at Los Angeles by George Pratt on behalf of the author, James Card, Curator of Motion Pictures, George Eastman House, 900 East Ave., Rochester 7, N.Y.
(This paper was received on November 3, 1958.)

Fig. 1. Projecting Praxinoscope invented by Emile Reynaud, 1880.

throughout the school year to groups from the area universities, secondary and elementary schools.

Such films in the collection as are not specifically restricted against public showing, are shown free to the public on Saturday and Sunday matinees at Eastman House. These free matinee programs continue throughout the year. Each screening is preceded by a lecture from one of the staff members.

The Dryden Theatre Film Society, with membership currently at 3000, meets at Eastman House for twenty programs each season. At these meetings, film programs are shown, also preceded by lectures concerning the history of motion pictures.

The Film Society is supplemented by two special study groups: the foreign-language group concentrates on a special series of German, French or Italian films and enables school groups working with these languages to attend the programs. The Cinema Seminar is a discussion group, composed of the most keenly interested members of the Film Society, which meets once a month to view films of highly limited interest or esoteric nature.

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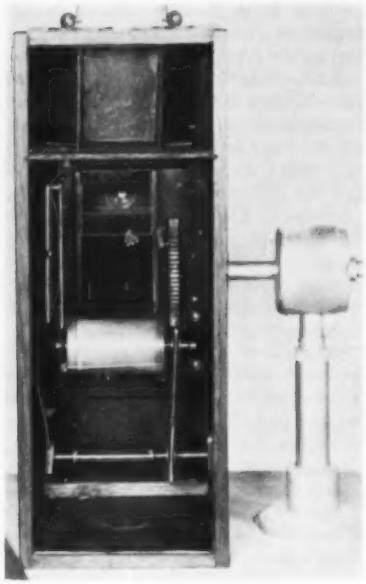

Fig. 2. Bouly's Cinematographe, a rare device, patented in 1892.

motion-picture cameras, projectors and associated equipment.

Many of the early cameras and projectors are on display and mechanized so that by pressing a button, visitors can examine the operation of the various types of intermittent movements characterizing these devices.

Among the extremely rare pieces, some of which exist in no other collection or institution, are the following:

Reynaud's Projecting Praxinoscope, 1880

In 1877, Emile Reynaud, the French inventor, developed his ingenious and very practical device (Fig. 1), which differed from existing zooetropes by having a strip of hand-painted pictures, mounted inside a revolving drum and reflected by similarly revolving mirrors. In the same year he patented his apparatus for projecting the pictures in apparent movement by combining his device with a magic lantern. The projecting Praxinoscope was completed in 1880. By 1892, Reynaud had expanded and enlarged the system to his Theatre Optique where his pictures were shown from perforated strips on a large theater screen, with the strips cued for sound effects.

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It is curious that French historians give priority to the Lumières for their Cinematographe which did not appear until 1894, at the earliest. Bouly's system, patented in France in 1892, and bearing the same name — Cinematographe — was thought for many years to exist only as a patent application. The device itself, in the Eastman House Collection (Fig. 2) is an extremely interesting combination camera-projector. It was designed to use film between 38mm and 48mm, although no positive film-size has ever been established. The film transport mechanism was a pair of friction rollers. The intermittent action was provided by broken rollers functioning with an intermittent grip. The shutter was a cylindrical drum with two openings. There is no available record of the practical use of this apparatus. Its ability to function adequately is improbable as the film transport system does not seem adequate to space images regularly on unperforated film.

Mutograph, 1895

The Mutograph produced the first motion-picture negatives for the American Mutoscope and Biograph Company and was probably the first motor-driven motion-picture camera in the United States. The Mutoscope, a peep-show viewing machine, is still in service in many penny arcades, but the ponderous Mutograph, the camera, is exceedingly rare (Fig. 3). It was invented by Herman Casler in 1895. It used unperforated film, 70mm in size. Average film length was 160 ft. Transport mechanism for the film was friction rollers and the intermittent was of the intermittent-grip type. Normal operating speed of the battery-powered, motor-driven camera was 40 frames/sec with a possibility of increasing the speed up to 100 frames/sec. Perforations were made in the film as it passed through the camera. The perforations were used to bring the images into proper register in printing. The perforator also functioned like registering pins to hold the film steady in the aperture at the instant of exposure.

Armat Vitascope: Inventor's Model, 1895

This prototype of the refined Armat Vitascope was made in October 1895. It used 35mm film with the standard Edison perforations. The intermittent was an eccentric cam, also known as a beater movement or dog movement and similar to the intermittent first devised by Demeny in France with his 1893 Chronophotographe. The Armat Vitascope (Fig. 4) was shown to Edison in December of 1895. When Edison was finally and belatedly persuaded by Raff and Gammon to authorize the screen projection of his Kinetoscope films, he decided to adapt the Armat Vitascope for this purpose rather than to attempt building a projector of his own. Thus it was only after widespread projections of the Kinetoscope films by unauthorized showmen using a variety of projectors, that Edison reluctantly permitted Raff and Gammon to install the "Edison" Vitascope, Armat type, in Koster & Bial's Music Hall for the undeservedly famous showing of Edison films in New York City on April 23, 1896. Although a plaque on the R.H. Macy store which occupies this site commemorates the event, the showing defi-

The Mutograph, an early motion-picture camera.

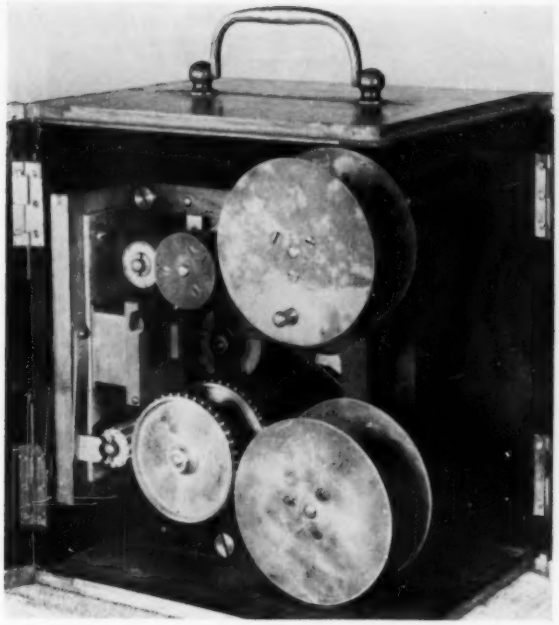
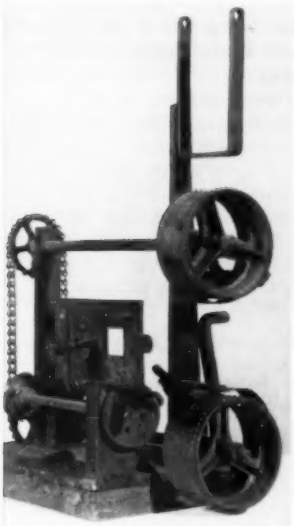


Fig. 6. De Bedts Kinetographe.

was not the first theater projection on pictures. It was simply the first g of Edison Kinetoscope films on a to a paying audience, which was zed by Edison himself.



Armat Vitascope (made about 1895). This model was used to rate motion-picture projection to A. Edison on December 8, 1895. ojector was said by its inventor Armat to be the first projecting using an essential loop-forming or the film and embodying a prac-termittent movement giving the the required long period of rest and

Chronophotographe (also known as the Biographe), 1893

The Demeny Chronophotographe is a motion-picture camera using 60mm, unperforated film. It was patented in France, October 10, 1893. The film transport mechanism was confined to the action of the take-up spool. The intermittent was the Demeny eccentric cam, beater, or dog movement.

Lumière Cinematographe, 1894

The Lumière Cinematographe (Fig. 5), the first eminently practical motion-picture camera-projector-printer, was patented in France, February 13, 1895. Lumière claimed that he exposed his first negative in the device, "Workers Leaving the Lumière Plant," at the end of 1894.

Fig. 5. Lumière Cinematographe.

Film size was 35mm with round perforations, two to each frame. Film length was 17 m. The intermittent movement was provided by a triangular eccentric shaft; film was transported by a pulldown claw. The shutter was circular and single-bladed.

Kinetographe, 1896

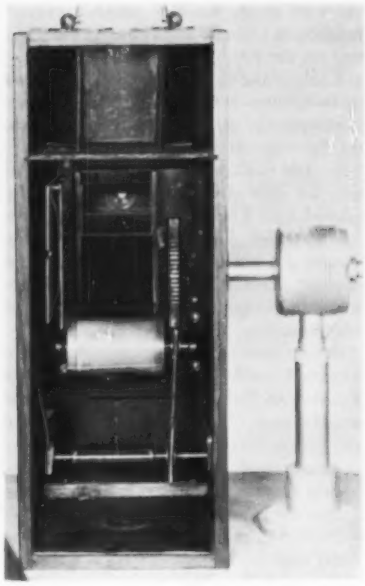
Rider De Bedts' camera-printer-projector (Fig. 6) was patented in France, January 14, 1896. It used 35mm film with Edison perforations in 30-m lengths. Film was transported by sprocket wheels. The intermittent was a wheel with three equally spaced teeth which at every revolution activates two other wheels sufficiently to replace one image with another. The apparatus could also be used for direct viewing like the Kinetoscope.

Phototachygraphe Sanson, 1896

This 35mm camera-projector was patented in France, March 5, 1896. It used film with Edison perforations transported with sprocket wheels. The intermittent was a notched sector oscillating from side to side which intermittently engaged the projecting teeth of a revolving wheel, then allowed the teeth to escape when the notch swung into position (Fig. 7). This device was used continuously and successfully at the Rouen Exposition in May 1896. It provided the greatest commercial competition in France to the Lumière Cinematographe.

Its inventor, Raoul Grimoin-Sanson also invented Cineorama, which was first presented to the public at the Paris World Fair of 1900, modified fifty years later as the Waller Cinerama and returned to Europe at the World's Fair in Brussels in

Fig. 1. Projecting Praxinoscope invented by Emile Reynaud, 1880.



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Armat Vitascope: Inventor's Model, 1895

This prototype of the refined Armat Vitascope was made in October 1895. It used 35mm film with the standard Edison perforations. The intermittent was an eccentric cam, also known as a beater movement or dog movement and similar to the intermittent first devised by Demeny in France with his 1893 Chronophotographe. The Armat Vitascope (Fig. 4) was shown to Edison in December of 1895. When Edison was finally and belatedly persuaded by Raff and Gammon to authorize the screen projection of his Kinetoscope films, he decided to adapt the Armat Vitascope for this purpose rather than to attempt building a projector of his own. Thus it was only after widespread projections of the Kinetoscope films by unauthorized showmen using a variety of projectors, that Edison reluctantly permitted Raff and Gammon to install the "Edison" Vitascope, Armat type, in Koster & Bial's Music Hall for the undeservedly famous showing of Edison films in New York City on April 23, 1896. Although a plaque on the R.H. Macy store which occupies this site commemorates the event, the showing defi-

Fig. 3. The Mutograph, an early motion-picture camera.

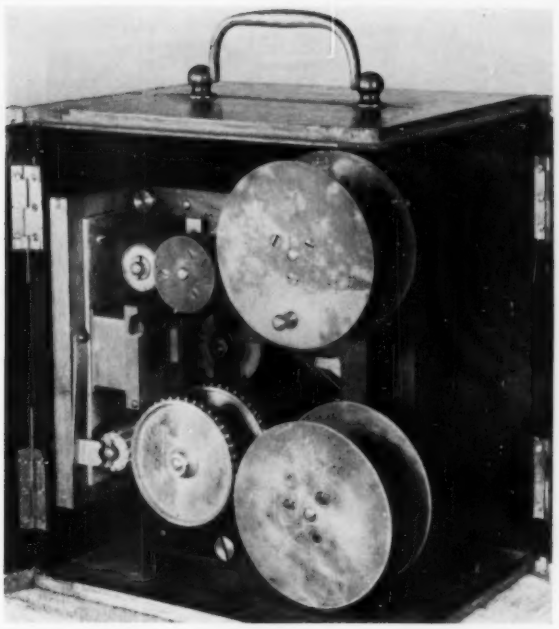


Fig. 6. De Bedts Kinetographe.

nitely was not the first theater projection of motion pictures. It was simply the first showing of Edison Kinetoscope films on a screen to a paying audience, which was authorized by Edison himself.

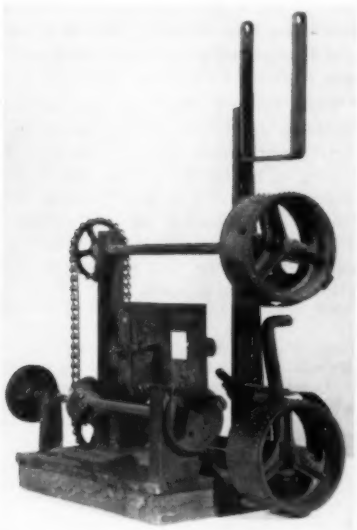


Fig. 4. Armat Vitascope (made about October 1895). This model was used to demonstrate motion-picture projection to Thomas A. Edison on December 8, 1895. This projector was said by its inventor Thomas Armat to be the first projecting machine using an essential loop-forming means for the film and embodying a practical intermittent movement giving the pictures the required long period of rest and exposure.

Chronophotographe (also known as the Biographe), 1893

The Demeny Chronophotographe is a motion-picture camera using 60mm, unperforated film. It was patented in France, October 10, 1893. The film transport mechanism was confined to the action of the take-up spool. The intermittent was the Demeny eccentric cam, beater, or dog movement.

Lumière Cinematographe, 1894

The Lumière Cinematographe (Fig. 5), the first eminently practical motion-picture camera-projector-printer, was patented in France, February 13, 1895. Lumière claimed that he exposed his first negative in the device, "Workers Leaving the Lumière Plant," at the end of 1894.

Fig. 5. Lumière Cinematographe.

Film size was 35mm with round perforations, two to each frame. Film length was 17 m. The intermittent movement was provided by a triangular eccentric shaft; film was transported by a pulldown claw. The shutter was circular and single-bladed.

Kinetographe, 1896

Rider De Bedts' camera-printer-projector (Fig. 6) was patented in France, January 14, 1896. It used 35mm film with Edison perforations in 30-m lengths. Film was transported by sprocket wheels. The intermittent was a wheel with three equally spaced teeth which at every revolution activates two other wheels sufficiently to replace one image with another. The apparatus could also be used for direct viewing like the Kinetoscope.

Phototachygraphe Sanson, 1896

This 35mm camera-projector was patented in France, March 5, 1896. It used film with Edison perforations transported with sprocket wheels. The intermittent was a notched sector oscillating from side to side which intermittently engaged the projecting teeth of a revolving wheel, then allowed the teeth to escape when the notch swung into position (Fig. 7). This device was used continuously and successfully at the Rouen Exposition in May 1896. It provided the greatest commercial competition in France to the Lumière Cinematographe.

Its inventor, Raoul Grimoin-Sanson also invented Cineorama, which was first presented to the public at the Paris World Fair of 1900, modified fifty years later as the Waller Cinerama and returned to Europe at the World's Fair in Brussels in

Fig. 7. Phototachygraphe Sanson, patented 1896.

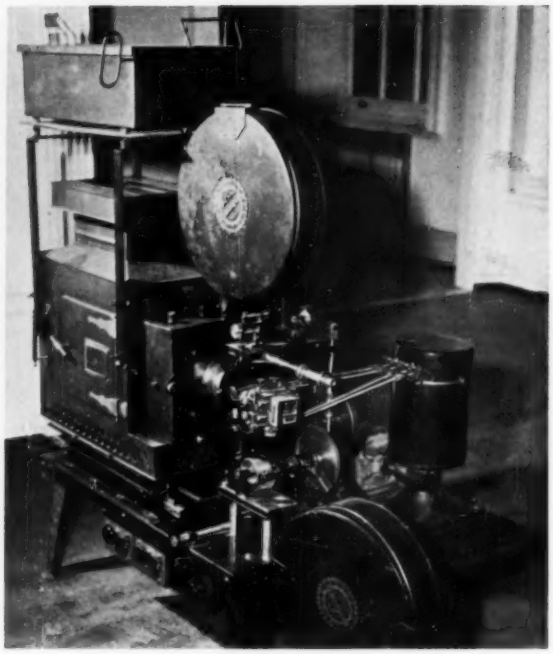


Fig. 8. Gaumont sound-color projector circa 1912.

the guise of Circarama, under the auspices of Walt Disney.

Gaumont Sound and Color System, 35mm

The Gaumont color system (Fig. 8) was a three-color additive process. Three lenses are used in the camera and three pictures (frames) are taken simultaneously through the primary color filters on a single strip of 35mm film, the frames of which are only three normal sprocket holes in height; one frame is exposed for each primary color so that the whole set of three color pictures corresponds to nine sprocket holes. Thus after each exposure the film must be advanced nine sprocket holes at a time. This is accomplished at a rate of 16 triple frames per second. The projector is fitted with a corresponding pulldown and gate and with three condensers and three sets of objectives with special registering devices.

Sound, which often consisted of lip-synchronized dialogue, was provided by high-quality disks amplified with compressed air. Synchronization was attempted through a system of rotating brushes and collector rings. By means of an electrically operated clutch, either one of two turntables could be rotated. A control panel was provided to be placed at the screen to synchronize sound and picture manually should the collector ring system fail to operate.

Other Items of the Collection

In addition to the devices just described, fifty pieces of motion-picture apparatus are on display at Eastman House, many of them mechanized. Over a hundred more are stored in the vaults as a study collection. Some three thousand motion-picture films are now available for screening at Eastman House and over six million feet of nitrate film is being held for eventual preservation on acetate stock.

There are still enormous gaps in the collection which the motion-picture department at Eastman House is constantly striving to fill in. But the prospects are encouraging and it is now possible for scholars and historians working with the collections at Eastman House to obtain useful clues to the real pattern of the history of motion pictures.

Discussion of Photographic Systems for Recording Shock-Wave Formations Produced by Supersonic Sleds

By NEIL R. KRENZEL

Four photographic systems — the shadowgraph, Toepler's schlieren, ballistic synchro, and the interferometer — are available for recording shock waves produced by aerodynamic configurations on track sleds traveling at supersonic velocities. A study has been undertaken at the Supersonic Naval Ordnance Research Track, China Lake, to determine which of these techniques are applicable to track-sled testing programs. A brief description of each system is given along with some preliminary test results obtained from the ballistic synchro system.

HIGH-SPEED TEST TRACKS offer the possibility of testing aerodynamic configurations to determine free flight characteristics at subsonic, transonic, or supersonic velocities. The tests can be performed under controlled conditions, and permit the recording of data by extensive instrumentation arrays.

A study has been made at the Supersonic Naval Ordnance Research Track to determine what systems are available for recording shock-wave patterns produced by supersonic sleds. Search of the literature indicates that there are four systems which can be used: the shadowgraph, Toepler's schlieren, ballistic synchro, and interferometer.

A closer look at these recording systems shows that they fall into two categories. The first — which includes the shadowgraph, Toepler's schlieren, and ballistic synchro — utilizes the refractive phenomena associated with rays of light traveling through a gas of varying density to form an image of the striations. The second category involves the interferometer, which, as the name implies, utilizes the interference of two monochromatic beams of light striking a plate or screen, either in phase or out of phase with each other, so as to form an image of the striation in the test area.

Presented on April 22, 1958, at the Society's Convention at Los Angeles by Neil R. Krenzel, Track Instrumentation Branch, Test Dept., U.S. Naval Ordnance Test Station, China Lake, Calif.

(This paper was received on September 29, 1958.)

Optical Paths of the Various Systems

The schematic diagram of the optical path characteristic of each system helps to show how the image of the shock wave is formed. Figure 1 shows the optical path of the shadowgraph system. The point-light source and the camera are located on the same side of the test section, and a reflective screen is used to return the light. The performance of the shadowgraph is based on the fact that rays of light from a point source travel in a straight line unless disturbed. Thus the outline of an object placed in the test section will be retained, and the shadow will be sharp even at large distances from the object. As the rays travel through the disturbed area surrounding the object traveling at supersonic velocity, they will be refracted, and a shadow will be formed which will show the pattern of striations in the test section.

The optical path of Toepler's schlieren system is shown in Fig. 2. As can be seen, this system has a much more complicated arrangement than the shadowgraph. The figure shows a simple one-mirror system. Due to practical limitations in the size of mirrors, it is more practicable to use a two-mirror system employing mirror diameters of two to four feet. Light from the source is focused on a knife edge, the knife being placed so that the edge just covers the image of the source under stable conditions. Thus, no light passes and the plate remains dark until a disturbance takes place between the knife edge and the mirror. The disturbance refracts the rays of light so they will pass over the knife edge and continue onto the plate, establishing a pattern on the plate which corresponds in shape to the pattern of the striation in the test section.

The optical path of the ballistic synchro system is shown in Fig. 3. The ballistic synchro camera utilizes the motion of the film past a stationary slit to compensate for the motion of the object image. This enables the object moving at high speed to be photographed without blurring. The shuttering action which takes place in this camera is similar to a focal plane shutter. In this case, however, the shutter slit is stationary and the film moves. The light from a background with horizontal black and white stripes is optically refracted as it passes through the shock-wave front, and the distorted stripes are recorded along with a picture of the object.

The schematic diagram of the optical path of the interferometer (Fig. 4) illustrates the complexity of this system as compared with the other three. For this system, a monochromatic beam of light is split, with one set of rays traveling to the observation plate undisturbed. The other set of rays passes through the test section and then to the plate. An interference pattern results, which, when compared to the steady-state condition shows the striations due to the phase shift of the rays in the test section.

Discussion of the Ballistic Synchro Technique

Some preliminary tests have been made using the ballistic synchro technique to determine the various factors involved in recording shock waves in this manner. Figure 5 is an example of the results that have been recorded. The

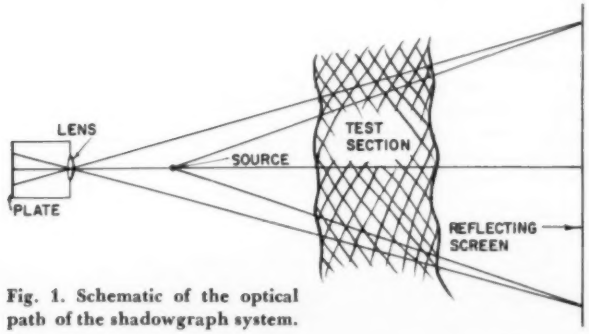


Fig. 1. Schematic of the optical path of the shadowgraph system.

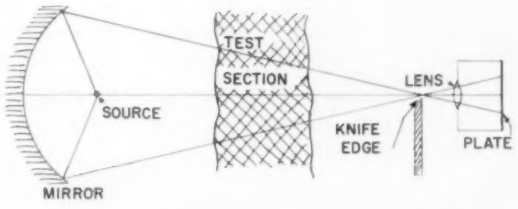


Fig. 2. Schematic of the optical path of a single-mirror schlieren system.

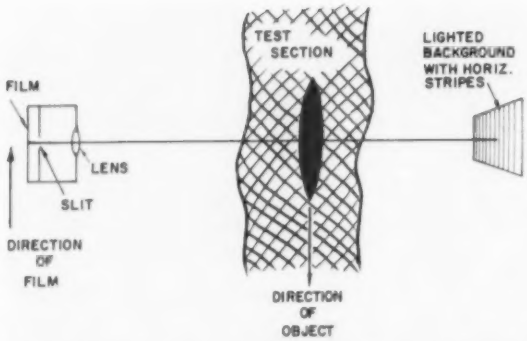


Fig. 3. Schematic of the optical path of the ballistic synchro system.

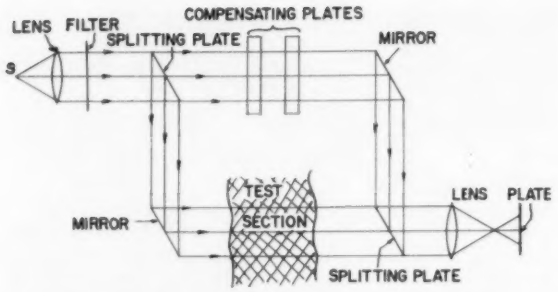


Fig. 4. Schematic of the optical path of the interferometer.

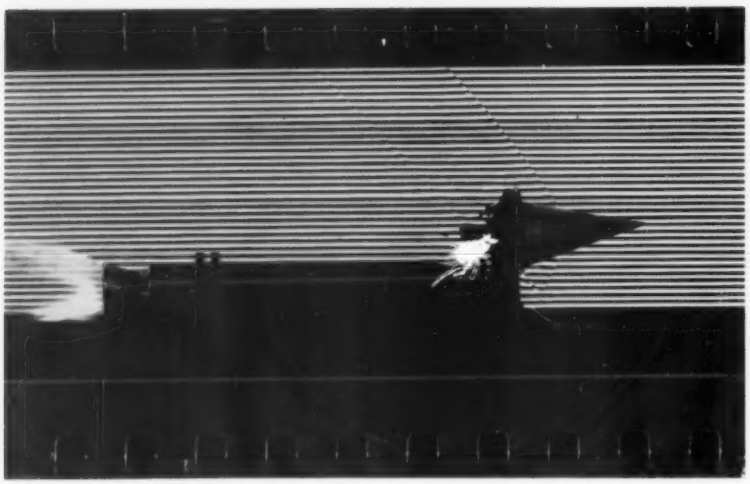


Fig. 5. Ballistic synchro picture of a supersonic test sled.

refraction of light with this system differs from that of the shadowgraph because the light is not emitted from a point source. With this system the light, which is reflected or emitted from the background, is refracted as it passes through the shock wave. This causes a displacement which is detectable when the background consists of a series of black and white horizontal lines. With a plain white background the shock waves are not visible unless very strong, in which case they appear as a thin line.

The shadowgraph effect has been observed with this system when the sun is in the right position to act as a source that casts a shadow of the shock wave on the object itself or on the background.

The point of focus does not appear to be too critical; however, slightly different results are obtained when the lens is focused on the background instead of on the moving object.

The synchronization of the speed of the film and the speed of the image is necessary to obtain good results. The difference in speed should be less than 10%; otherwise, the blur tends to obscure the shock waves.

Field Use of Shock-Wave Recording Instrumentation

It is important to realize that track testing is performed in an environment which precludes the use of any apparatus that requires precise alignment or critical adjustment, or that is sensitive to temperature variation. Also, the equipment must be sufficiently rugged to survive transport from place to place along the track and to withstand the wind and sand encountered in a desert climate.

Three of the above-mentioned systems meet the overall requirements — the shadowgraph, Toepler's schlieren, and the ballistic synchro. The interferometer, because of the extensive components involved and the manner in which it is operated, is not suitable for track use.

The comparative simplicity of the recording method of either the ballistic synchro system or the shadowgraph enables them to obtain an overall view of the test item, covering a 12-ft test section. The schlieran system can be used to cover smaller areas of specific interest where more detailed analysis is required. Both 4 by 5-in. stills and motion pictures can be recorded with the shadowgraph system.

Use of Shock-Wave Photographs

The records obtained by these various systems will be of value qualitatively more than quantitatively. This is due to the complex relationship between the film density and actual density of the air surrounding the test item. With the interferometer, the density of the air itself is recorded. The schlieren system records the first derivative of the density of the air, and the shadowgraph system records the second derivative. The ballistic synchro system records only a displacement of a light beam and this has little quantitative value. However, information of considerable value can be obtained. Both the shadowgraph and Toepler's schlieren systems can be used to record such phenomena as (1) boundary layer flow transition, (2) short-wave formation, (3) transonic flow condition and (4) interaction between shock waves. The ballistic synchro system can be used to obtain data on shock-wave formation and the interaction between shock waves.

Reference

The following report has been a reference:

Holloman Air Force Base, New Mexico, Final Report on Schlieren Development (Large Field Photographic System for Analysis of Shock Wave Patterns and Related Phenomena), 15 February 1956 — 30 April 1957 reporting period, Edgerton, Germeshausen & Grier, Inc., Boston, Mass., and Las Vegas, Nev., Report No. 1603.

Photographic Method for Hypervelocity Measurements

By D. A. HALL

A slit camera has been designed to permit reliable velocity measurements in low-pressure chambers too small for ballistic pendulums. At two or more viewing ports along a horizontal trajectory, the shadow of the projectile is cast upon a vertical slit. A reduced image of each slit is focused on a film transported in a standard high-speed camera. Timing marks also are put on the film by means of a flashing strobe light. These, together with the measured displacement between projectile images, permit computation of the velocity. The system appears to be the most satisfactory means of attaining accurate hypervelocity measurements. It has been operated with excellent results over a variety of base lengths and gun sizes.

RESURGENCE of interest in the ballistics of high-speed projectiles has intensified the need for a reliable system of hypervelocity measurements. Because of limitations imposed by available guns, most early investigations of external ballistics were carried out at terminal velocities below 6000 ft/sec. In this range, various reliable methods for velocity measurements were available, the choice dictated only by factors such as the availability of apparatus, physical layout of the range, and the accuracy desired.

For one reason or another, most of the schemes for measuring velocities below 6000 ft/sec have either limited or no utility in hypervelocity research programs where projectile speeds may exceed 15,000 ft/sec. The ballistic pendulum, for instance, has long been considered a standard for projectile velocity measurements, but it has one "expensive" feature which virtually eliminates its utility in hypervelocity measurements. To achieve a low natural frequency and low friction, the ballistic pendulum requires a relatively long suspension. But long suspensions occupy space, and space is very costly to provide in the low-pressure chambers required for high-velocity projectile experiments.

Since hypervelocity experiments must be carried out at reduced pressures, the use of conductive screens and electronic timers at first appeared quite attractive. Exhaustive trials with various screens, pulse-forming circuits, and counters, however, left much to be desired. Apparently, ionization attending the projectile passage tends to maintain conduction after the projectile has broken the screen. The result is uncertainty as to the instant of breakage and the nature of the material which breaks the screen.

Because of these and other difficulties encountered with conventional tech-

A contribution submitted on November 20, 1958, by D. A. Hall, Ballistics Branch, Mechanics Div., U.S. Naval Research Laboratory, Washington 25, D.C.

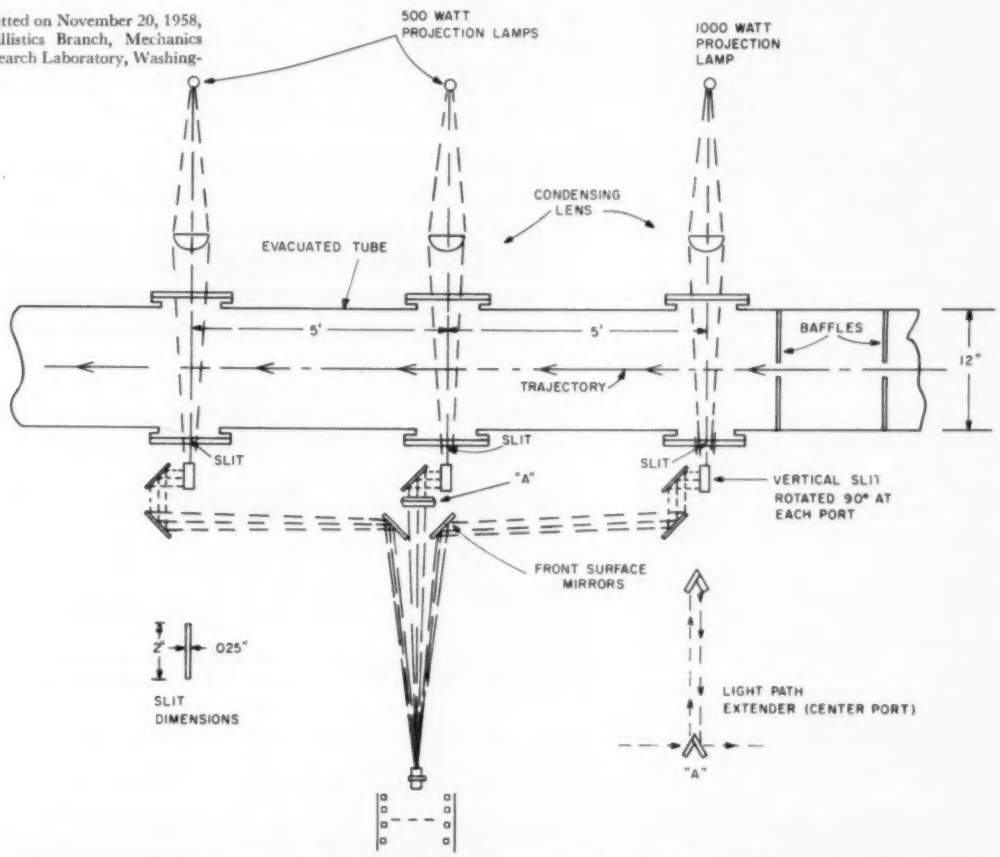


Fig. 1A. Schematic of three-port velocity-measuring system arranged for 12-in. evacuated tube. Path extender for center port is shown at lower right.

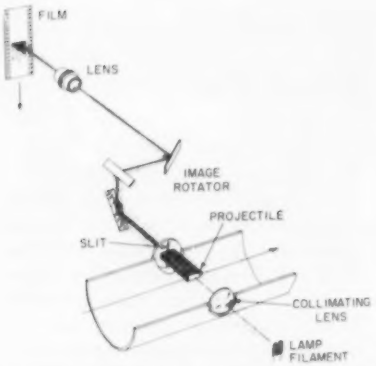


Fig. 1B. Detail of the system-focusing the image.

niques, recourse to a photographic method for hypervelocity measurements seemed justified. A system devised at NRL appears to be the most satisfactory means of attaining accurate velocity measurements and is now used exclusively in our ballistic studies. All components can be easily obtained commercially at a minimum of cost. The system has been applied at base lengths of 25, 28, and 120 in., and with various models of the NRL hypervelocity gun. In each case the results have been equally satisfactory.

The first experiments, to test the feasibility of a photographic method, were conducted with a hypervelocity, light-gas (helium) gun, designed by Clark and Boltz of thi Laboratory. In these experiments a Fastax framing camera was used to record the projectile velocity in free flight in an open range. Air friction made the projectile self-luminous to a degree which permitted photography at 16,000 frames per second without additional illumination. The obvious clarity of the recorded velocity was indeed impressive and led to further studies in low-pressure chambers.

Attainment of similar results in an evacuated range poses several problems not present in an open range. Small-spaced windows in a closed tube permit only a glimpse of the projectile, and the chance that an open frame would occur simultaneously with emergence of the projectile at a window could not be assumed. Furthermore, the projectile is no longer self-luminous at reduced atmosphere, so that external illumination is required.

A satisfactory solution to the problems of closed-range photography has resulted from a judicious combination of simple optical components and a Fastax camera with the framing prism removed for use as a film conveyor. Such a system, with three viewing ports on a 12-in. tubular range, is illustrated in Fig. 1A. A narrow vertical slit on each port is viewed by the camera through suitable

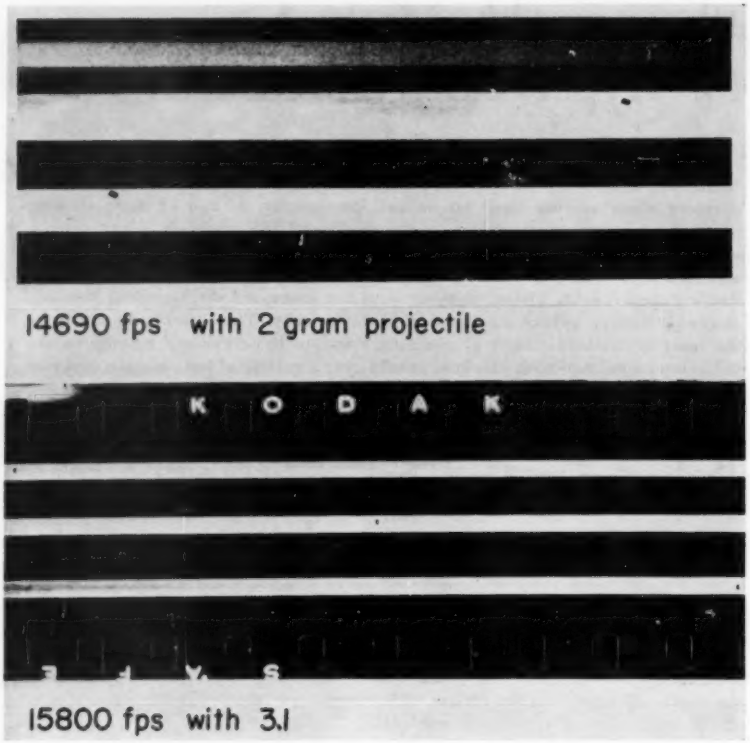


Fig. 2. Typical velocity records: Above—negligible foreshortening, two-port system with 25-in. base length and 0.22-in.-diameter projectile traveling at 14,690 ft/sec. Below—considerable foreshortening, three-port system with 120-in. base length and 0.50-in.-diameter projectile traveling at 15,800 ft/sec. (Note that foreshortening of the silhouettes has not affected the velocity record.)

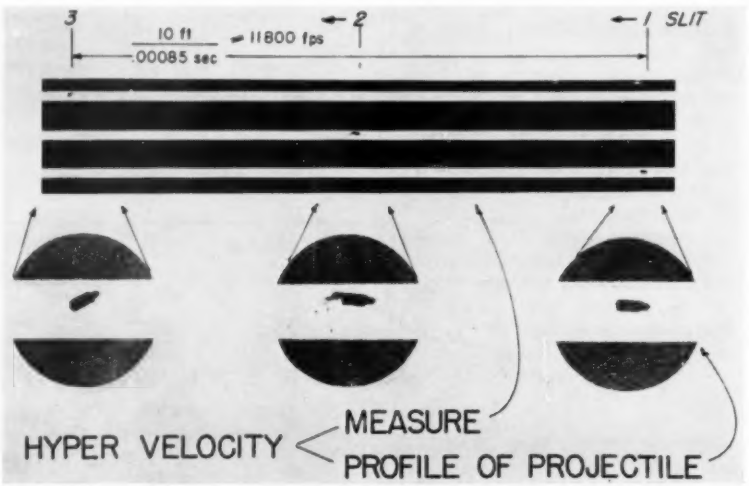


Fig. 3. Typical velocity record and enlarged projectile silhouettes. Since film is swept downward, images appear in reversed order, i.e., first port to right.

mirrors. A collimated light beam* is projected onto the opposite side of the slit through an opposite port window.

*It should be noted that the "collimated beam" is not truly parallel. It converges slightly toward the slit and thence to a point at the camera lens, by which means greater image intensity is obtained.

As the projectile enters the light beam, it casts its shadow onto the slit, thereby blanking light from a height equal to its instant lateral dimension. A reduced image of the slit, as blocked by the projectile shadow, is focused across a fast-moving 16mm film (Fig. 1B). As the projectile proceeds past the slit,

the film is moved past the slit image in the camera, thereby wiping on a profile of the projectile.

If the film speed can be matched to the projectile speed divided by the image-reduction factor, an undistorted profile of the projectile is obtained; otherwise, longitudinal distortion will result. Maximum film speed i: timed to coincide with the projectile shot by use of the frame counting-synchronizer previously developed at NRL (See Rept. NRL Progress abridged on pp.151and152. When the camera is operated at maximum voltage rating, film speeds of about 200 ft/sec are ava lable. At a projectile velocity of 10,000 ft/sec an optical reduction of 50 would be required to avoid distortion of the profile. Even at projectile speeds two or three times this value, the profile would still be recognizable and could be readily decompressed to allow determination of projectile shape and yaw. Examples of shadowgraphs obtained both with and without foreshortening are shown in Fig. 2.

Velocity is measured by converting the displacement between the images appearing on the film into time intervals, which, of course, gives the time required for the projectile to pass from one slit to another on the range. Film speed is measured from 1000-cycle/sec timing marks exposed on the film by means of a flashing strobe light. With a 10-ft base length between slits and a film speed of 200 ft/sec, it is estimated that velocity can be determined within an error or no more than 0.5% and probably within less than 0.1%. A typical velocity record and enlarged projectile silhouettes are shown in Fig. 3. The appearance of a streaming corner wake at the center-port shadowgraph is an interesting detail which nonphotographic methods would be incapable of recording.

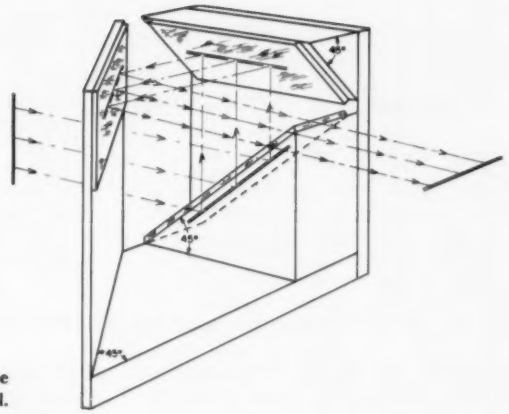


Fig. 4. Diagram of image rotator, vertical to horizontal.

In high-speed operation, the Fastax camera should be operated in upright position, with its film motion vertically downward. But the slits which must be projected horizontally onto the film are vertically disposed. The necessary 90° rotation of slit images is accomplished with the three-mirror assembly shown in Fig. 4.

The addition of a third viewing port increases the certainty of obtaining a useful velocity record and opens up the possibility of determining air drag. But with three ports the camera lens is closer to the central slit than to the end slits, and the paths' lengths are unequal. In order for the camera to focus on all three slits, the path to the central slit must be lengthened with a four-mirror path extender (Fig. 1A).

Resolution of the projectile profile in the direction of motion will improve as the slit opening is narrowed. Reduction of slit width, however, reduces the exposure level on the film. Optimum design thus requires a discriminate compromise between sacrifice of exposure level and longitudinal resolution. In the present system, ample exposure of Eastman Tri-X Panchromatic Negative Film, Type 7233, through a slit 0.012-in. wide is obtained with 1000-w projection lamps collimated by 6-in. condensing lenses of 9-in. focal length. With an optical reduction factor of 50 and film speed of 200 ft/sec, exposure duration is only 0.1 μsec.

Because of the limitation in resolution imposed by film grain size and optical resolving power, a larger image size would be desirable. It must be remembered, however, that the optical reduction factor governs only the lateral scales of the images; the longitudinal scale is simply the ratio of projectile speed to film speed. Thus there is nothing to be gained by reduction factors smaller than that required for equal lateral and longitudinal scale factors. Furthermore, the unexposed portions of film width could be utilized for other views of the projectile.

Synchronization of a High-Speed Prism Camera by Frame-Counting Technique

ABRIDGMENT

By D. A. HALL
and S. O. BAILEY

DEVELOPMENT OF motion-picture cameras capable of framing rates as high as 17/msec has made possible the scientific and technical investigations of transient phenomena of less than one-millisecond duration. Synchronization of such phenomena with the very high framing speed now possible is not easily accomplished with conventional timing apparatus, however, because of the uncertainty inherent in camera speed characteristics. An improved system has been developed at the Naval Research Laboratory in which the picture frames are counted electronically, and the event to be photographed is triggered after a preset count has been reached, independent of the time required to reach a given point on the length of film. Precise location of the desired data with respect to the film length often eliminates the necessity of processing an entire 100-ft roll of film, thus greatly expediting the completion of records. All components in this system are commercially available at a total cost comparable with conventional timing apparatus.

This is an abridgment of a Naval Research Laboratory Progress Report of September 1957 by D. A. Hall and S. O. Bailey, Ballistics Branch, Mechanics Division, U.S. Naval Research Laboratory, Washington 25, D.C.

System Components

Components of the system include a variable-reluctance probe, preamplifier, electronic counters, and relays for power-control (Fig. 1).

Probe: The probe consists of a coil wound on a permanently magnetized core which is pointed on one end. The pointed end of the core is placed

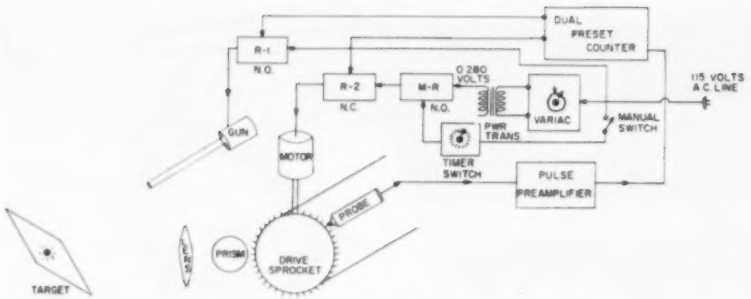


Fig. 1. Diagram of components assembly in the synchronization system.

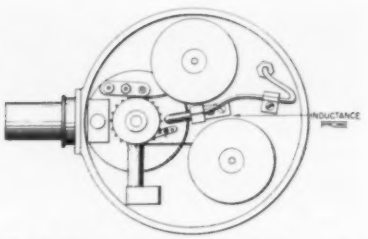


Fig. 2. Diagram of the mounting for probe in relation to driving sprocket.

in registry with the steel teeth of a film-driving sprocket (Fig. 2). As each tooth on the wheel passes the end of the probe, the magnetic flux through the coil is rapidly changed and a voltage impulse is obtained from the coil. These voltage pulses are amplified, then fed to a dual preset counter.

Preamplifier: The output voltage generated in the probe will increase with framing rate. With the voltage sensitivity available with the present dual preset counter, counting will commence at a framing speed of about 800/sec (8-mm frame height). When the high-speed prism camera is operated at a peak framing rate above 8000/sec, only about 2½ ft of film will pass before counting begins. For many purposes, this lag in the beginning of the count will be tolerable and no preamplifier will be required.

If the camera is to be used at lower framing rates, it will be necessary to provide additional pulse amplification. A single stage of amplification, with a voltage gain of 10 at all frequencies between 70 and 10,000 cycles per second, is sufficient.

Counters: Counters for the present application are of a type capable of actuating a relay after a predetermined count has been reached. Since a 100-ft roll of 16mm film has about 4000 perforations, a total count of 4000 is required. The counter purchased by NRL for this purpose (Berkeley Model 5445A) can count 100,000 — a limit well in excess of the requirement because of intended adaptation to other laboratory tasks. For use with the high-speed camera, fast-acting relays were installed at the factory.

Power-Control Relays: A heavy-duty, mercury relay (M-R) is used to connect power to the driving motors in the camera (Fig. 1). The Fastax Camera Model WF1 draws a current of 11 amps during operation of 280 v. The contacts in the fast-acting relays supplied with the counter are rated at only 5 amp. Supplementary relays R-1 and R-2 are employed to obtain the additional current-carrying capacity. Relay R-1 is for controlling the event (such as the firing of a gun) and is used with the contacts normally open. When the first "preset" count is reached, the counter relay closes, energizing R-1 through which current for the event is carried. The event-controlling relay may be pulsed or closed and held closed, depending upon the requirements of the event. This option is selected by appropriate controls provided on the counter. Relay R-2, normally closed, is provided to cut off the camera motors when the second preset count is reached. Relay controls are set in the hold position for the camera cutoff function.

System Operation: Operation of the system begins when the manual switch is closed by the operator. This switch connects power to the "timer switch" and activates the heavy-duty, mercury relay (M-R). After a number of pulses equivalent to a desired position on the film have been counted, the first fast-acting relay (R-1) operates to initiate the event. The event is then photographed. After an additional count corresponding to arrival of the end of film, the second relay (R-2) turns off the power supplied to the camera.

Use of this system requires a knowledge of the inherent delay between the initiation of an event and the stage of development afterward, at which it should be photographed. In trial runs, the event can be triggered well back from the end of the film so that the delay can be measured directly from the record. This delay, reckoned in terms of the corresponding number of frames at the highest framing speed, can then be set in the counter.

With this system, short lengths of 16mm film can be readily processed in the field without the elaborate facilities needed to handle a whole roll. Precise positioning of the record further allows economy in the use of film, as the unexposed portion can be re-used. Splicing a short piece of sensitive film (say 10 ft) onto a long unsensitized leader (90 ft) is suggested as another possibility for reducing film costs, provided that a suitably strong junction can be effected. The leader, by its location in the slower moving part of the film, should suffer little damage by its passage through the camera and thus should be re-usable.

Accurate setting of the position at which power cutoff is effected has materially reduced the damage to the end of the film roll by whipping action. By the avoidance of overspeeding once the end of the roll is reached, the life expectancy of the high-speed rotating parts should materially increase.

The authors are grateful to their associates in the Mechanics Division and particularly to J. A. Kies and J. M. Krafft for helpful discussions and encouragement in this development.

Photographic Instrumentation in Field Test Operations

By LINCOLN L. ENDELMAN

Many problems are encountered in the use of instrumentation photography under field conditions. These problems include damage to equipment caused by temperature changes, humidity, depredations of animals and insects, and other environmental problems. Methods of meeting such problems and protecting cameras and equipment are discussed.

PHOTOGRAPHIC instrumentation is becoming increasingly important as a tool of scientific research for the furtherance of industrial and governmental programs. (The art of photography encompasses the science of measurement and becomes a tool for the scientist or engineer to use for the determination of precise bits of information.) With increased reliance on photographic instrumentation there is also an increase in the number and kind of problems involved in its use, especially under field conditions.

Environmental Problems

Problems directly connected with environmental conditions may require, for their solution, activities ranging from swamp-filling and land-clearing to mixing insecticides to control the insects so destructive to equipment. In certain projects the necessity for large unobstructed areas requires the type of terrain which tends to make camera coverage difficult. Clearing land for camera pads creates engineering problems. It frequently happens that special roads must be cut through the wilderness so that equipment can be brought through. Elevated platforms or mounds must be constructed for the cameras; swamps must be filled so that a camera can be mounted far enough away to cover the entire scene. A special power line may be needed to carry the voltages necessary to run the cameras. If it is not feasible to run such a line, battery power or portable generators must be provided.

Field tests, especially for military agencies, are usually conducted in long stretches of uninhabited open country and in desolate areas. Usually, too, few facilities, other than those provided by the agency conducting the program, are available.

Dirt is more than a minor hazard. Dust and dirt jam close tolerances of high-speed cameras. To protect the cameras, special precautions are taken, such as covering them with plastic covers and canvas bags and paying strict attention to replacement of lens caps.

Another serious problem is that of moisture. Not only do rain, snow and fog delay operations, but also excessive humidity requires special protection of equipment to prevent rust. Animals and insects also create serious problems in field operations. Rats and wild animals may chew through insulation and break lines. Relays which are used to start cameras often provide convenient nesting places for little rodents. But, annoying as the animals can be, it is the insects that are the real marauders. Swarms of gnats appearing between the lens and the subject, gears jammed because insects have crawled into small holes in the camera — these along with the personal discomfort inflicted on the cameraman by hordes of bloodthirsty mosquitoes — make any workable method of insect control of immediate importance.

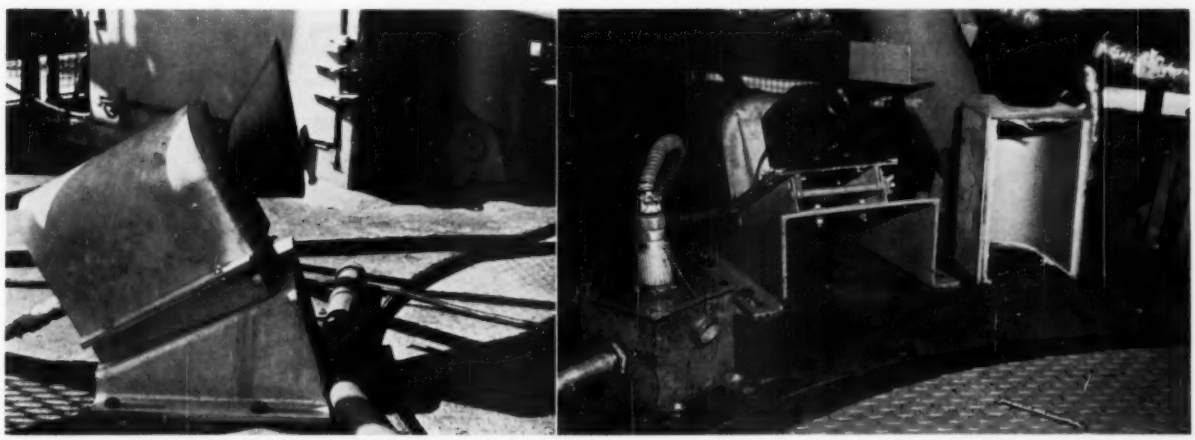
Special attention must, of course, be paid to storage problems. Refrigerating facilities must be provided especially for high-speed film, infrared and other films especially sensitive to heat and humidity.

In the actual taking of photographs, the lighting is often far from ideal. Early morning haze or smoke may cause bad color balance. Heat waves shimmering in front of telescopic lenses may cause distortion. Late afternoon sun and the long shadows from forested areas make it necessary to use the widest possible lens apertures. Reflectors are necessary to provide illumination in dark shadow, and camera speed must be slower to compensate for poor light conditions.

Lighting conditions frequently dictate the use of black-and-white film. Black-and-white 16mm can usually be processed with small portable tanks, but 35mm or color film must be sent to a processing laboratory which often involves long delays and security problems.

In studies involving explosives, the cameras must have special protection (Figs. 1A and 1B). They may be enclosed in boxes made out of $\frac{1}{2}$-in. boiler plate with 1-in. thick quartz windows or bulletproof glass to prevent shrapnel

Presented on October 24, 1958, at the Society's Convention in Detroit by Lincoln L. Endelman, Convair-Astronautics, Cocoa Beach, Fla.
(This paper was first received on September 29, 1958, and in final form on March 5, 1959.)



Figs. 1A and 1B. Protective boxes for Milliken Cameras installed on top of ATLAS launching stand flame deflector. In Fig. 1B box is removed to show camera.

Figs. 2A and 2B. Protective boxes for Milliken and TN-9 gun cameras. Hanging from launcher is TN-9 gun camera box made of ½-in. boiler plate with 1-in. thick bullet-proof glass protecting lens. Figure 2B shows damage after missile launching.

Fig. 3. ATLAS complex camera pad with remotely controlled TV camera and protective sandbag enclosure.

from damaging the camera (Figs. 2A and 2B), and they may also need to be protected from concussion and falling rock by blast walls and sandbagged enclosures.

Remote control equipment (Fig. 3) is a necessity for many types of both military and industrial research. Cameras are started and stopped by the use of microswitches and relays hooked into sequential timers, or event-actuated controls. A special wiring circuit is used to provide timing marks, which correlate with a series of test occurrences, and also to correlate cameras with one another. At times, radio-actuated pickups start the cameras. Some elaborate installations contain remote control equipment to pan and tilt and change focus on zoom-type lenses.

The uncertainty associated with most field tests makes the short running time of high-speed cameras a serious handicap. A safety factor is added by the use of multiple-camera installations.

In many tests it is necessary to use telescopic lenses or wide-angle lenses to photograph the varied subjects. Special lenses with fiducial marking, or extremely wide angles and long focal lengths, are often needed to provide details of the complete path of action.

Equipment and Personnel

Increasing importance of photographic instrumentation has created requirements for new equipment and for modification of existing equipment. The demand for both equipment and trained personnel has outrun the supply. Training programs for engineers and technicians are all too few. Repair and maintenance of equipment also present problems because of scarcity of the required precision equipment. All of these handicaps combined with the special problems incident to field tests present a challenge. Solutions to these diverse problems, some of which will depend upon the ingenuity of technicians in the field, and others upon the vision of those responsible for training programs, will certainly be found. It can be predicted that new equipment will be invented or developed to keep pace with growing demands.

Discussion

Samuel E. Blackwell (Chrysler Corp., Missile Div.): I wonder if you normally use 70mm or 35mm for your camera, or do you use a combination?

Mr. Endelman: We use 16, 35 and 70. The IGORs and ROTIs use 70; the IGOR can use 35. Our other instrumentation cameras consist of 16–35mm Fastaxes, 70mm Hulchers, Flight Research and Photosonic cameras and, as I said, the CZR which uses 5½-in. aerial film.

Mr. Blackwell: Do you use color as well as black-and-white in the different camera setups, the same combinations?

Mr. Endelman: We use a combination — we attempt to use as much color as possible. If the operation is a night operation, of course, we're forced to use more black-and-white, but normally we attempt to use color.

Mr. Blackwell: Thank you.

Society of Motion Picture and Television Engineers

The Fontainebleau from the garden

85th Semiannual Convention and International Equipment Exhibit

Exhibit Directory and Advance Papers Program

Hotel Fontainebleau

May 3-8, 1959

Miami Beach, Florida

Also, with TV, Havana, May 8

MIAMI is more than just a vacationland. Besides the attractions of beach and pool, SMPTE members will find much to interest them. The sunny climate makes this a fine location for photographing; the nearby University of Miami at Coral Gables has an energetic and enthusiastic film department — and an SMPTE Student Chapter; there are seven TV stations in town or nearby; and the numerous missile and rocket installations within the state offer plenty of activity for the data recording and instrumentation enthusiasts.

Garden and pool area

Outline of Program

Sunday

10:00–5:00 Registration

Monday

9:00 Registration
10:00 High-Speed Photography and Instrumentation
12:15 Get-Together Luncheon—Guest Speaker: Mitchell Wolfson
2:00 Laboratory Practices
7:45 Address by Major General John B. Medaris
8:30 High-Speed Photography and Instrumentation

Tuesday

9:00 CONCURRENT SESSIONS
Audio-Visual Communications
High-Speed Photography and Instrumentation
1:30 Equipment Papers and Demonstrations
7:30 Projection and Cinematography

Wednesday

9:00 CONCURRENT SESSIONS
Sound
Studio Lighting and Practices
1:30 Committee Meetings
6:45 Cocktail Party, Banquet, Dance

Thursday

9:30 Multilingual Films
1:30 Television Film Techniques

Friday

9:00 Television Facilities
1:30 Television Recording

Saturday

Special Trip to Patrick AFB and Cape Canaveral

Exhibit Directory

Animation Equipment Corp. Booth **22**
38 Hudson St., New Rochelle, N.Y.

Exhibiting: OXBERRY UNISTAND—for animation, titles, filmstrips, enlarging and copying in 3-to-24-field range. Single-column construction with traveling table or compound and camera carriage. Available either with vertical (8-ft ceiling) or horizontal mount; accommodates 16 & 35mm cameras. Full line of accessories.

Personnel: Ed Willette, Bob Tracy.

Bell & Howell Company Booths **28, 29**
7100 McCormick Rd., Chicago 45, Ill.

Exhibiting: Specialized cameras and related instrumentation equipment designed for missile-scoring programs; cameras for industrial applications; time and motion projectors.

Personnel: Chuck Musson, Carl Stauff.

Equipment Papers and Demonstrations

Tuesday afternoon, May 5, from 1:30 to 5:00, exhibitors will present the following equipment papers and demonstrations. Additional papers and demonstrations scheduled after this list is published may be given at another time, to be announced at the Convention.

Animation Equipment Corp: The New Oxberry Unistand.

Camera Equipment Co.: CECO Blimp for Maurer Camera.

Eclair: Perfectone Model EP6A Magnetic Tape Recorder.

Electronic Applications, Inc.: Model 140 (West German) Reverberation Unit; Nagra (Swiss) Recorder; 0815 Monitor Speaker.

Flight Research, Inc.: AUTEX, Automatic Exposure Control for Instrumentation Cameras.

Florman & Babb, Inc.: Portman Animation Stand; New F & B Effects Stand.

Kling Photo Corp.: New Arriflex 16; New Arriflex 35; New Anamorphic Lenses.

Magnasync Mfg. Co. Ltd.: New Studio Mixing Consolette.

Paromel Electronics Corp.: Stop-Motion Projector.

RCA Film Recording: Lightweight Portable Magnetic Recording System.

S.O.S. Cinema Supply Corp.: Tel-Amatic 16/35mm Negative/Positive Film Cleaning Machine.

Vicom, Inc.: Self-Contained 16mm Magnetic Re-recording Machine.

Wollensak Optical Co.: WF4S 16mm 4000-ft Stop-Start Fastax Camera.

Benson-Lehner Corp. Booth **38**
11930 W. Olympic Blvd., Los Angeles 64

Exhibiting: Benson-Lehner HS-16B High Speed Camera; Vinten HS300 High Speed Camera; Vinten Pan and Tilt Head, Type III, and Tripod; Vinten Television Pedestal; Vinten HS-16 High Speed Camera; Dekko Type N Instrumentation Camera.

Personnel: Donald B. Prell, Guy H. Hearon, Howard (Bud) S. Weisbrod.

Birns & Sawyer Cine Equipment, Inc. Booth **27**
8910 Santa Monica Blvd., Los Angeles 46

Exhibiting: New underwater equipment; gyropod gimbal tripod; stop-motion 35mm projector; barneys for Arriflex cameras, etc.

Personnel: Jack Birns, Jack Pill.

Camera Equipment Company Booths **20, 21**
315 West 43 St., New York 36

Exhibiting: New CECO blimp for Maurer Camera; CECO programming device for time-lapse photography; stop-motion motors; CECO fluid-head tripod; vidicon tripod and dolly; CECO 16 & 35mm professional film viewers; variable-speed camera motors; indoor remote pan-and-tilt head.

Personnel: Burton H. Zucker, Clifford Van Praag.

Century Lighting, Inc. Booth **34**
1477 N.E. 129 St., North Miami 61, Fla.
521 West 43 St., New York 36

Exhibiting: New C-Core (Silicon Controlled Rectifier) Dimmer; light-weight photographic and studio Fresnelites, Pattern Lekolites and accessories; data on studio lighting systems.

Personnel: Edward F. Kook, George Gill, Rollo G. Williams, Bert Berend, Wib Newman, Gregory Salisbury, Gus Hogshead, Miguel Moenck, Jr., John K. Hughes.

Société de Gérance des Etablissements Cinématographiques Eclair Booth **19**

12 rue Gaillon, Paris 2°, France.
U. S. Rep.: Benjamin Berg Co.,
1410 Van Ness Ave., Hollywood 28

Exhibiting: New synchronous recording equipment, consisting of Perfectone Model EP6A $^1/_4$-in. Magnetic Tape Recorder, coupled with a blimped Camerette with Pan-Cinor zoom lens.

Personnel: Benjamin Berg.

Electronic Applications, Inc. Booths **32, 33**
194 Richmond Hill Ave., Stamford, Conn.

Exhibiting: Nagra IIIB, 3-speed, transistorized portable, direct-driven, film-synchronized tape recorder (Switzerland); Studer "30" mains-operated, constant tape tension and direct-drive tape recorder (Switzerland); Model 140 Reverberation Unit (West Germany); Model 24B and Model 28 Studio Microphones; Model 0815 Monitor Loudspeaker; Model 418 Wow and Flutter Test Set.

Personnel: Messrs. Hoisl, Kudelski, W. Turner, H. Sampson, Jr., and V. J. Skee.

Flight Research, Inc. Booth **39**
P. O. Box 1-F, Richmond 1, Va.

Exhibiting: Photo instrumentation equipment, including 16, 35 and 70mm synchronized multidata cameras and accessories; 35mm AUTOMAX Data Recorder; new transistorized intervalometer; AUTEX Automatic Exposure Control for instrumentation and documentary cameras.

Personnel: Wm. T. Curdts, III, C. A. Gregory, Jr., John C. Pennock, Donald Bass.

Florman & Babb, Inc. Booths **46, 47**
68 West 45th St., New York 36

Exhibiting: Portman Animation Stand and complete line of accessories; Triplex Triple-Duty Animation, Title Stand and Product Stage; Ampex Recorder; miscellaneous F & B products.

Personnel: Warren Portman, Arthur Florman, Len Hollander.

Hollywood Film Co. Booth **4**
956 N. Seward St., Hollywood 38, Calif.
524 West 43 St., New York 36

Exhibiting: Heavy-duty Power Rewind; Hand Rewind with Video Tape Adapter; Negative Rewind Break-down Unit; Table Model Hot Splicer for 35, 65 and 70mm film; FSC-1 Table Model Combination Hot Splicer for 16, 17½, 35-32, CinemaScope and 35mm film; Elbow Type Combination 16 and 35mm Tightwind, TWC-2; 16mm Edge Numbering Machine.

Personnel: Ben and Harry Teitelbaum, Sheldon Kaplan.

Houston Fearless Corp. Booths **30, 31**
11801 W. Olympic Blvd., Los Angeles 64

Exhibiting: 16mm Color Labmaster for processing Ektachrome and Anscochrome, with accessories; complete line of new plastic valves, plastic pump and other plastic fittings.

Personnel: A. J. Kjontvedt, Paul Sparre, Lou Girola, Jack Jiruska.

Kling Photo Corp. Booths **40, 41**
257 Fourth Ave., New York 10
7303 Melrose Ave., Los Angeles 46

Exhibiting: Arriflex 16, with automatic buckle switch, sprocket roller guides and motor cable lock; Arriflex 35, Model II BV, with variable shutter; Taylor Hobson Cooke Lenses for Arriflex Cameras; Macro-Kilar F 2.8 Lens in Arriflex mount; Gossen Sixticolor Color Temperature Meter; Arri and Arriflex accessories.

Personnel: Dr. Robert Richter, Paul Klingenstein, Victor James, George Lissauer.

Lipsner-Smith Corp. Booth **36**
100 Van Winkle Dr., Falls Church, Va.

Exhibiting: Model CF-2 Ultrasonic Film Cleaning Machine—cleaning film by means of ultrasonic cavitation in a bath of safety solvent, with rapid drying device, 3000-ft capacity.

Personnel: LeRoy Bartels, J. S. Lipsner, M. A. Lipsner, D. Pearl, Ely Smith, E. Werner.

Magnasync Manufacturing Co. Ltd. Booths **42, 43**
5546 Satsuma Ave., North Hollywood, Calif.

Exhibiting: Consoles; dubbing and recording equipment; electrical interlock; equalizers in a typical system plan for sound stage; mobile "Safari" sound truck system; new semi-professional recorder.

Personnel: D. J. White, W. H. Stutz, Howard Auchstetter.

D. B. Milliken Co. Booth **37**
131 N. Fifth Ave., Arcadia, Calif.

Exhibiting: 16mm High-Speed Cameras, speeds from pulse to 400 pictures per second; intermittent movement with registration pin: DBM 3—100 ft, DBM 4—200 ft, DBM 5—400 ft, DBM 6—Scoring Camera, N-11—Underwater Bell.

Personnel: T. H. Truesdell, R. S. Guild.

Moviola Manufacturing Co. Booth **8**
1451 Gordon St., Hollywood 28, Calif.

Exhibiting: Moviola Crab Dolly; 16mm Sound and Picture Editing Machine; Rewinders; Sound Readers; Synchronizers.

Personnel: Mark Serrurier, Mrs. Mark Serrurier.

Paromel Electronics Corp. Booth **18**
3956 W. Belmont Ave., Chicago 18, Ill.

Exhibiting: 35mm Stop-Motion Projector; Special Studio Model 35mm Projector.

Personnel: M. D. Shoberg, M. R. Shoberg, H. M. Fisher.

Precision Laboratories Booth **25**
1037 Utica Ave., Brooklyn 3, N. Y.

Exhibiting: Precision Sound Readers for editing optical or magnetic soundtracks; synchronizers; magnetic attachments for synchronizers; film slitters; editing devices for picture and sound.

Personnel: Irwin R. Sheldon.

RCA Film Recording Booth **6**
411 Fifth Ave., New York 16
1016 N. Sycamore Ave., Hollywood 38

Exhibiting: New MI 10004 Dialog Microphone; new lightweight portable magnetic recording system; dual magnetic dubbing unit; magnetic bulk eraser.

Personnel: Everett Miller, Jack Leahy.

Ro-Nan Plastic & Manufacturing Co. Booths **1, 2**
6161 Cedros Ave., Van Nuys, Calif.

Exhibiting: 16mm Continuous Color Developing Machine for Ektachrome (7255), Anscochrome and Eastman color films; soundtrack applicator; silver recovery units; 8/16mm slitter; Ott Levitt type squeegee.

Personnel: Cec L. Sly, J. Carl Treise, Sidney Walker.

S.O.S. Cinema Supply Corp. Booth **26**
602 West 52 St., New York 19
6331 Hollywood Blvd., Hollywood 28

Exhibiting: Tel-Amatic 16/35mm Negative/Positive Film Cleaning Machine; Tel-Anima Soundstriper Magnetic Striping Machine for 8/16mm Film; Tel-Animastand with Electronic Zoom; S.O.S. Junior Tripod; Tel-Animaprint Hot Press; Auricon Cameras; Forney Cinetron Power-Packaged Lighting Systems; Moy Film Edge Numbering Machines, etc.

Personnel: Dominick J. Capano, Jerome P. Schlesinger.

Studio Supply Co. Booth **35**
711 S. Victory Blvd., Burbank, Calif.

Exhibiting: Hallen transistorized portable magnetic film recorder; Sony and Neumann/Telefunken microphones; UltrAudio CustoMixer portable mixer amplifiers; StudioSound equalizers and filters, pads and networks; knobs, patch cords, jacks, connectors, switches, etc.

Personnel: Oliver Berliner, Kitty Kennedy.

Time Automated Mfg. Co., Inc. Booth **44**
1760 Winfield St., Rahway, N. J.

Exhibiting: Semi-portable, clutch-driven, 800-lb, 16mm black-and-white and color processor, for Anscochrome, Ektachrome, Kodachrome or Kodacolor.

Personnel: George Vaughn, Nick Djadjich.

Unicorn Engineering Corp. Booth **3**
1040 N. McCadden Place, Hollywood 38

Exhibiting: High-speed solvent film cleaning and rewinding machine; powered film rewind; "Robot" automatic light changer; film tape splicer; high-speed air-vacuum film cleaning and rewinding machine.

Personnel: Louis Behrmann, Carl Hunt, Ben Teitelbaum, Harry Teitelbaum, Sheldon Kaplan.

Vicom, Inc. Booth **14**
70 Aberthaw Rd., Rochester 10, N. Y.

Exhibiting: Self-contained 16mm magnetic recording machine; high-speed television lenses; photographic resolution test reticles.

Personnel: Fred E. Aufhauser, John P. Seabourne.

Wollensak Optical Co. Booth **45**
850 Hudson Ave., Rochester 21, N. Y.

Exhibiting: Fastax-Fastair High-Speed Cameras and professional lenses, including the new WF-4S and WF-3T Fastax Cameras; 70mm Pro-70 Lenses; new WF-8A 35mm full frame Fastax Camera.

Personnel: Fred M. Emens, Richard R. Youso, Norman Kuegler.

Zoomar, Inc. Booth **13**
Glen Cove, Long Island, N. Y.
1586 Crossroads of the World on Sunset Blvd., Hollywood 28

Exhibiting: Automatic exposure control for long-range telephoto lenses, also adaptable to tracking instruments and phototheodolites; optics for television, for use with image orthicon or vidicon; industrial television lenses, remote control.

Personnel: Walter Steuer.

Advance Program

This program is as complete and accurate as possible at press time—but there may be errors and there probably will be some changes for the Final Program. If attendance at a session is now being planned for only a specific paper or two, members are advised to inquire during the week before the Convention by telephoning to SMPTE Headquarters in New York (LOngacre 5-0172) or to Gar Misener, Program Chairman, c/o Capital Film Laboratories, Washington, D.C. (LAwrence 6-4634), or to Herbert Farmer, Regional Papers Chairman, Los Angeles (RIchmond 8-2311, Exts. 328, 269, 200).

SUNDAY—MAY 3

10:00–5:00 Registration in the Fontainebleau, Miami Beach

MONDAY—MAY 4

9:00 Registration

10:00 HIGH-SPEED PHOTOGRAPHY and INSTRUMENTATION

Photographic Instrumentation in the Avro CF-105 Arrow

LOU T. WISE, *Avro Aircraft Ltd., Toronto, Canada*

The Avro CF-105 Arrow represents an advanced concept in high-speed, long-range, two-man interceptors. Photographic instrumentation required for recording technical data related to missile launching and tracking, as well as general aerodynamic and functional investigation, is quite extensive and must function under extreme environmental conditions. Aerodynamic considerations at 1.5 times the speed of sound, availability of space, frame rates, g loads, angular coverage of lenses and lens- periscope systems, and stop-start ability of cameras were among the problems involved.

New, Compact Light Sources for High-Speed Photography

WILLETT R. WILSON, *Lamp Div., Westinghouse Electric Corp., Bloomfield, N. J.*

Small and especially compact incandescent light sources are frequently needed when recording high-speed phenomena in crowded spaces. Self-contained reflector lamps have been designed considerably smaller than previous types and with an improved beam pattern. They require no auxiliary equipment and types are available for use on aircraft voltages.

A New Technique in Digital Film Data Recording

I. A. SONDERBY and R. G. McPHERSON, *Magnavox Research Laboratories, Los Angeles*

Film data recording provides a means of obtaining permanent records of equipment in operation, together with instantaneous recording of pertinent test information. The use of a newly developed Digital Recording Head suggests a number of possible applications in photographic reconnaissance, flight tests, engineering tests, etc. Additional data, such as time, flight number, temperature, and shaft position, may be necessary for optimum use of the pictorial record.

12:15 Get-Together Luncheon

Guest Speaker: Mitchell Wolfson, President, Wometco Theatres, Inc., Miami, Fla.

MONDAY AFTERNOON

2:00 LABORATORY PRACTICES

Setting Up a Cinematographic Department and Color Laboratory in Cuba

PABLO EPSTEIN, *Telecolor, S. A., Havana, Cuba*

When Channel 12 was set up in Havana as a color TV station depending exclusively on film for its programming, Telecolor was set up as its cinematographic branch. This paper describes personnel training methods and discusses operation and control problems and their solutions. The use of Anscochrome and single-system sound procedures for newsreels are evaluated.

Practical Application of Control Methods in Small Laboratory Operation

F. J. QUINN, *Trans-World Film Laboratories Ltd., Montreal, Que., Can.*

Many small laboratories have been built, particularly in Canada, as a result of the establishment of local TV stations. These laboratories are generally staffed by one or two experienced people and a number of inexperienced people. There are many useful, practical aids to establishing and maintaining control methods at low cost.

Como Establecer y Mantener el Balance de Luz de Copia, Usando un Sistema de Azar Controlado, al Hacer Copias Aditivas en Color—(Establishing and Maintaining Printer Light Balance in Additive Color Printing by a System of Controlled Chance)

PABLO TABERNERO, *Laboratorios Alex, Buenos Aires, Argentina*

The problem treated in this paper does not refer to the process of timing color negatives, but to the necessity of maintaining uniform color quality from print to print. A definite color balance for a given set of printing conditions must be established. This balance will often depend on unknown quantities such as shifts in relative color sensitivity of print materials from coating to coating. General stability conditions of an additive printing process are mentioned. A system of controlled chance is defined. Essentials of the system proposed are enumerated and described. Some mathematical reasons for the selection of an adequate number and sequence of possible printer-light trial combinations are discussed. Economic considerations are discussed briefly.

Full Automatic Loop Printing System

MARIO CALZINI, *Tecnostampa Labs, Rome, Italy*

A fully automatic loop printing system, arranged to print reel by reel of 35mm color and black-and-white sound films at a rate of about 113 ft/min has been developed. When a predetermined number of prints has been made from a given negative reel, the next reel is brought automatically into place. Printing is resumed after no more than the 60 seconds required for the automatic splicing of the two reels. Loading elevators containing picture negative and sound negative are automatically adjusted according to the length of the negative entering during both the printing and the replacing.

Atlantic Missile Range Cine Processing Laboratory

WALLACE F. BISCHOF, *Patrick Air Force Base, Fla.*

The laboratory has been designed and is operated to give commercial quality cine processing at the world's largest missile testing center. Films processed include Anscochrome 16mm, 35mm and 70mm; Eastman Color Negative; and all commonly used black-and-white films. Many innovations in processing systems and equipment have been made for economy's sake, without compromising quality; and unusual features have been designed for the local environment.

Motion-Picture Processing Equipment for Guided Missile Research

JOHN P. DELANGRE, *Houston Fearless Corp., Los Angeles*

Certain design features of eleven film processors and auxiliary equipment recently installed at the Patrick Air Force Base Motion Picture Laboratory are discussed. The processors are of modular construction. Major changes in the processing schedule can be made by rearrangement of the modular tank units. The film-drive system, type of construction and materials selected for various components are described. The overall system includes a simplified liquid-level control system with a siphon break and chemical system, located on a separate floor, for preparation and handling of processing solutions.

An Automatic Hot Splicer

JOHN NEWELL, *Western Cine Service Inc., Denver, Colo.*

A motion-picture film splicer, incorporating a power-driven rotary knife to accomplish film scraping has been developed. The motor and heating element have the same 115-v source. Construction of the device and its applications are described.

MONDAY EVENING

7:45 Address by Major General John B. Medaris, Commanding General, U. S. Army Ordnance Missile Command, Huntsville, Ala.

8:30 HIGH-SPEED PHOTOGRAPHY and INSTRUMENTATION

Photography of Simulated Atmospheric Re-entry Tests of Missile Nose Cones

B. H. MOLLBERG, *Missile Div., Chrysler Corp., Detroit*

The re-entry problem encountered by a ballistic missile nose cone is introduced. The test facility and procedures used to design, develop and qualify the tactical body of the Redstone Missile are described. Full-size missile structures are tested at ambient and elevated temperatures. Photographic procedures are discussed, with emphasis on such problems as photographing subjects of comparable brightness to that of the sun, controlling batteries of 15 to 25 motion-picture and rapid-sequence cameras, mounting them in a limited space and protecting them from extremely high temperatures. Included in the presentation is a film showing re-entry runs and slides illustrating the test specimen, furnace and camera-mounting techniques.

A Photogrammetric Triangulation System

ALFRED K. SCHIEFNER, *Instrument Corp. of Florida, Melbourne Fla.*

A brief description of a photogrammetric triangulation system is presented, with emphasis on the philosophy of application. The problem of maintaining accurate trajectory surveys while expanding the system for global use and, in addition, increasing the system's flexibility and mobility, is set forth, along with the solution thereof. Global "shutter sychronization" is described in terms of accuracy, reliability and economy.

New Observations of Explosive Phenomena by Submicrosecond Color Photography

MORTON SULTANOFF, *Ballistic Research Labs., Aberdeen Proving Ground, Md.*

The use of color photography at submicrosecond exposure times has been accomplished by use of recently developed cameras, emulsions and lighting techniques. The study of explosives has been extended to include heretofore unobserved phenomena by use of the Beckman & Whitley 25-frame re-imaging camera operating at exposure times of 0.12 μsec. Super Anscochrome film, force-developed for both maximum exposure index and restoration of color balance, exposed to the direct light of the explosion and the reflected light of argon-filled explosive flashlamps, produced unexpected fidelity of color, and revealed events not previously recorded with black-and-white films. An animation, produced and played back as a moving-picture sequence which will be shown as part of this paper, reveals and clarifies the motion of these newly recorded phenomena.

TUESDAY MORNING—MAY 5
CONCURRENT SESSIONS

9:00 AUDIO-VISUAL COMMUNICATIONS

A Comparison of Learning Resulting from Motion-Picture Projector and from Closed-Circuit TV Presentations

J. F. McGRANE, *American Machine and Fdry. Co., Alexandria, Va.;* and MORTON L. BARON, *Signal Equipment Support Agency, Fort Monmouth, N.J.*

In an attempt to standardize Military Service requirements for motion-picture projector noise levels, training films at various projector noise levels were shown to students. The same films were also shown over a closed-circuit TV system to equivalent groups. A comparison of the results obtained with respect to "learning" is presented. Tests were made before and after each presentation. It is shown that the projector is the superior training device, provided low noise levels are maintained.

Closed-Circuit Television in School and Community: The Chelsea Experiment

LAWRENCE CRESHKOFF, *Chelsea Closed-Circuit Television Project, New York*

Industrial vidicon cameras, master antenna distribution system and standard home receivers are used in a community TV station which links an elementary school, settlement house, city health center and public housing project in New York City. The instructional programs are handled by two men: the technician, who presets cameras and lights and controls video-audio; and the teacher, who operates four cameras and has charge of his own props during telecast.

Implications of the Continental Classroom for Open-Circuit Television Teaching

EDWIN P. ADKINS, *AACTE National Coordinator, % National Broadcasting Corp., New York*

Audio-Visual Communications in Missile Training

COL. H. S. NEWHALL, *Commandant U. S. Army Ordnance Advance Guided Missile School, Redstone Arsenal, Ala.*

Professional Motion-Picture Training, Liberal Education and the Communication Arts Curriculum

A. NICHOLAS VARDAC, *College of Communication Arts, Michigan State Univ., East Lansing, Mich.*

For at least half a century educators have been plagued by the dilemma of undergraduate choice between liberal education and professional training. A clear-cut discussion differentiating the aims of scholarship and of practical training has been needed as well as a concept that would identify common values and merge certain areas of both kinds of education. This paper examines motion-picture training and its potential for meeting both liberal arts and the professional training objectives of the university.

CONCURRENT SESSION

9:00 HIGH-SPEED PHOTOGRAPHY and INSTRUMENTATION

A Silent 16mm Projector for Military Use

A. E. NUPNAU and EDWIN L. SMITH, *Bell & Howell Co., Chicago*

A silent 16mm motion-picture projector has been developed for the Air Force in accordance with Military Specification MIL-P-4523. The projector is used for viewing and assessing film exposed in 16mm gun cameras. Features include local and remote control of 360° rotation of projected image, focusing, framing, forward and reverse, and single-frame projection. Film speeds are variable from 14 to 32 frames/sec.

Automatically Synchronized Pulse and Cine Instrumentation Cameras

C. A. GREGORY, Jr., *Flight Research, Inc., Richmond, Va.*

Accurate sychronization of time of exposure among a group of cameras can often greatly simplify the reduction of data. Described are two methods of achieving sychronization: one is accurate to one millisecond and available for both pulse and cine operation in 16mm and 35mm cameras; the other, accurate to about 100 microseconds and available for high-speed cine operation in a full-frame 70mm camera and adaptable to other camera systems.

Automatic Real Time Flight Determination

EARLE B. BROWN, *Farrand Optical Co., New York*

Methods currently used for the reduction of tracking data are extremely costly. Recent developments attack parts of this problem. An automatic real time theodolite can be built at the present state of the art, with three specific techniques: electronic angular measurement, analog-to-digital conversion, and measurement of focal-plane tracking error. The methods have been developed to permit building a "Super-Theodolite" to provide automatic real-time data at accuracies as high, or higher, than can now be achieved. For short ranges, ranging capability can be added to obtain complete trajectory data from a single station. The techniques available for this application are described and illustrated.

Production Planning for Contractual Film Progress Reports

WILLIAM F. ROMEIKE, *Martin-Baltimore, Baltimore, Md.*

Filmed classified progress reports have become increasingly important as a medium of information and communication. The purpose of these reports differs from that of the usual nontheatrical production but the production of films for natural defense projects has often been approached in a conventional manner. Unconventional but practical solutions are suggested for the daily problems in scheduling, personnel assignment, budgeting and coordination with the military at test centers.

TUESDAY AFTERNOON

1:30 EQUIPMENT PAPERS and DEMONSTRATIONS

(See the Directory of Equipment Exhibits on earlier pages.)

TUESDAY EVENING

7:30 PROJECTION

Horizon Sag Compensation for Projection on Wide Screens

JOHN D. HAYES, *Bausch & Lomb Optical Co., Rochester, N.Y.*

The combination of the curved screen used by several motion-picture processes, the high angle of projection of many theaters and the low angle of view from the auditorium of these theaters to the screen causes a phenomenon termed "horizon sag." This paper describes an optical projection system designed to eliminate, or significantly reduce, the horizon sag as observed on the screen from the auditorium of the theater.

Optical Characteristics of Rear Projection

JOHN F. DREYER, *Polacoat Inc., Blue Ash, Ohio*

Rear-projection screens of low reflection reduce the effects of light on the screen and allow increase in the ambient light. Goniophotometric curves and setup of screen are given. Distribution, gain, reflection and resolution are discussed as factors. The physiological effects of increased ambient light are considered. The brightness of the picture should at least equal the level of the surrounding light to which the eye is adapted.

The Standardized 16mm JAN Projector

GEORGE W. REUTELL, *Bell & Howell Co., Chicago*

The 16mm Sound Projector was established by the Projection Equipment Committee under Standardization Working Group 402-40E of F.S.C. Group 67. The transition from three different projectors used by the Army, Navy and Air Force to a single projector was accompanied by design improvements for the new projector.

CINEMATOGRAPHY

A High-Speed Color Negative Film

MERLE L. DUNDON, *Film Emulsion and Plate Mfg., Eastman Kodak Co., Rochester, N.Y.*

The new 35mm camera film, Eastman Color Negative Film, Type 5250, has been designed to replace Type 5248. The new film has a similar structure, but is twice as fast as the older film. This permits exposures under more difficult lighting conditions, or with greater depth of field or more economy in set lighting. Processing and printing procedures are similar to those for Type 5248. Minor differences in characteristics of the two films are discussed.

Photography of Atlantic's Farthest Shores

NEWMAN BUMSTEAD, *National Geographic Society, Washington, D.C.*

A talk-film.

Are ASA Speed Numbers Accurate?

JOHN ARVONIO, *Photo-Magnetic Sound Studios Inc., New York*

The history of the sensitometry underlying the various film speed systems of the past and also the present ASA Speed Criteria are reviewed briefly as an introduction to a discussion of the exposure-time problem and its relationship to the two competing film systems, Weston and ASA. The mathematical treatment of this problem tends toward oversimplification, making it possible for important complex variables to be overlooked. This accounts for the readiness with which many investigators have pictured an ideal concept of the exposure problem and for the assumptions which have been made which, in essence, have created a false picture of the problem. After examination of the significant variables to be considered in an exact determination of photographic exposure, concrete proposals are offered for a modification of ASA Speed Criteria to reflect more fully the exposure-time problem.

WEDNESDAY MORNING—MAY 6

CONCURRENT SESSIONS

9:00 SOUND

A New Approach to Location Recording Techniques

JACK J. CLINK, *Byron Motion Pictures Inc., Washington, D.C.*

A new approach to location recording techniques which has special interest for the independent producer who prefers to do his original recording utilizes the many advantages offered in presently available magnetic recording channels. As a result, the sound service studio will receive better and more consistent material for a final re-record or transfer.

Magnetic-Recording Amplitude Uniformity Measurements

WALTER L. ANDERSON, *General Kinetics, Inc., Arlington, Va.*

Experiments involving new measuring and calibrating methods were set up to obtain quantitative information on dropouts in magnetic tape recordings. Measurements of reproduced signals

were made on various types of tapes and tape brands; and parameters such as mean peak amplitude and relative standard deviation were computed. The latter expression defining signal uniformity relates to signal-to-noise ratio for analog recording and to error rates for digital recording. Results of the experiments indicate that amplitude uniformity is degraded by tape use, storage and ordinary winding practice.

Magnetic-Tape Damage from Causes Other Than Wear

ROBERT P. GUTTERMAN, *General Kinetics, Inc., Arlington, Va.*

Tape damage in storage and shipment, deriving from inappropriate reel design and winding practice is predicted theoretically and confirmed experimentally. Results apply to motion-picture films as well. Damage also occurs during transient tensile overload. Transient tensions measured in actual recorders are compared with tape-tensile curves obtained at corresponding rapid strain rates.

Planning an Integrated Sound System for the 16mm Studio

D. J. WHITE, *Magnasync Manufacturing Co., Ltd., North Hollywood*

Selecting equipment for a small facility requires as much consideration as for laying out a major studio. Integrated systems have important values; and pitfalls can be avoided by careful planning, especially with complete understanding between engineer and manufacturer. Emphasis is given foreign dealings where the language barrier inhibits communication.

Single-Double System Recording Facilities for the Amateur and Semiprofessional

W. H. STUTZ, *Magnasync Manufacturing Co., Ltd., North Hollywood*

A new concept for the recording of "lip-sync" sound by the amateur and semiprofessional is applied with the camera mounted on the miniature transistorized recorder and driven by the synchronous recorder motor. One channel on the split 16mm film is used for lip-sync and the other is used to dub in music and sound effects.

A Battery/Sine Wave Power Supply Using Solid State Techniques

D. P. GREGG, *Westrex Corp., Hollywood*

A portable solid state power inverter has been designed to drive one or more cameras and an associated sound recording system. Operating silently and with high efficiency from automobile-type batteries, it provides up to 200 w sine wave at 50 or 60 cycles with adequate margin for motor starting. New approaches have been made to the problems of voltage regulation and frequency stabilization, and new circuit protection features are incorporated.

A Low-Cost Transistorized Re-recording Mixer

G. A. BROOKES and G. W. READ, *Westrex Corp., Hollywood*

A compact table-mounted, six- or eight-input, single-channel, re-recording mixer has been designed for small studio applications. Transistorized modular subassemblies provide each mixer circuit with gain control, program and midrange equalizers; an additional transistorized subassembly includes an overall gain control and test oscillator. Complete mixer console facilities have been incorporated. Highly reliable operation and performance requirements comparable to those of major studios have been achieved.

A Versatile Multiple-Unit Re-recorder

H. A. MANLEY, *Westrex Corp., Hollywood*

A re-recorder has been designed for small studio use, incorporating in one cabinet up to four magnetic reproduce units driven by a common motor. The units may be any combination for either 35, 17½, 16mm or ¼-in. perforated film, one of which may be equipped for magnetic recording, and a second for optical reproduction. Newly designed transistorized amplifiers have been incorporated.

Dual Dubber

C. E. HITTLE, *Radio Corp. of America, Hollywood*

A unique arrangement of the essential components for a new dual magnetic reproducer is described. Such a combination leads to a 2 to 1 reduction of plant floor space as compared to earlier equipment of similar design. Construction features of a new dual film-drive mechanism used in this dual reproducer are also described.

CONCURRENT SESSION

9:00 STUDIO LIGHTING and PRACTICES

Rigging for Television Studios

RALPH H. SCHNEELOCH, JR., *Inter American Equipment Co. Inc., Miami, Fla.*

Rigging is used to handle lighting equipment, scenery, curtains, props, etc. This paper discusses equipment suspended overhead or from the walls, including dead-hung systems grids, tracks, battens and rigging for flying. Architectural design, as it affects rigging, is discussed.

Significant Developments in Studio Lighting Layouts

ROLLO GILLESPIE WILLIAMS, *Century Lighting, Inc., New York*

Important developments in preset memory systems, cross connecting of control circuitry, and remote-controlled lighting units are effecting significant changes in electrical and lighting studio layouts. Variable color lighting for Chroma-Key and other studio purposes is considered together with the effects of dimming on the spectral quality of light from different sources. Required brightness levels for monochrome and color work are reviewed, together with the latest lighting methods. The control of light from xenon and other types of discharge lamps is discussed.

A Multi-PAR Lamp Luminaire for Light Projection for Stage Lighting

F. E. CARLSON, *Large Lamp Dept., General Electric Co., Nela Park, Cleveland, Ohio*

The properties of the sealed-beam types of tungsten filament lamp are utilized in a luminaire, the characteristics of which include: substantially higher peak beam candlepower at narrower beam spreads than have been reported for tungsten filament spotlights of comparable wattage; oval or approximately rectangular beam patterns of rather precise angular dimensions by the use of refractive plates on or in front of the lamps; a step type of dimming control that does not alter the color temperature of the composite beam. These features and the methods of obtaining them are discussed.

The Silicon-Controlled Rectifier Dimmer

HERBERT R. MORE, *Kliegl Bros. Universal Electric Stage Lighting Co., New York;* and ALBERT W. MALANG, *American Broadcasting Co., New York*

Development of this semiconductor device as a portable plug-in module has brought new concepts to lighting, with greatly reduced volume, weight and heat generated per kilowatt and without sacrifice of electrical characteristics. Advantages compared with current methods are demonstrated and these advantages are related to a new systems concept. The application in a new broadcasting center is described.

New Horizons

PAUL F. WITTLIG, *CBS Television Network, New York*

New staging devices have been designed and techniques developed to overcome limitations on creative efforts, imposed by the physical boundaries of studio walls and grids. Among these, VideoScene, an electronic camera system designed to blend live action with miniature settings, is described. A film produced by the author illustrates the use of the new equipment and techniques.

WEDNESDAY AFTERNOON

1:30 COMMITTEE MEETINGS

WEDNESDAY EVENING

6:45 COCKTAIL PARTY, BANQUET, DANCE

THURSDAY MORNING—MAY 7

9:30 MULTILINGUAL FILMS

Chemical Subtitling of Positive Films

DAVID OPOCHINSKY, *Titra Film Labs Inc., New York*

From among the various systems of subtitling, chemical subtitling has been universally adopted for color film. Subtitling films for television is discussed. The Titra system consists of: preparatory work, galleys and stencils; protective paraffin coating; stamping; bleaching; and removal of the paraffin coating.

Spotlight on

Gevapan 30, Type 165 is favored by experienced cameramen all over the world. This film gives uniform results, even when the shooting schedule calls for both interior and exterior shots. The fine grain and excellent gradation give extremely good definition with excellent tone rendition. The special sensitivity of this film also minimizes make-up and other photographic problems.

Negative films
Duplicating films
Sound recording films
Positive films
Reversal films
Gevacolor films
Magnetic film

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A Multilingual Audio-Visual System

HOWARD M. TREMAINE, *Lookout Mt. Air Force Station, Hollywood;* JAMES W. GREEN, *Magnasync Mfg. Co., Ltd., Hollywood;* and GLENN R. OSBORN, *Lookout Mt. Air Force Station, Hollywood*

An audio-visual system has been designed with a 16mm rear-projection system, electrically interlocked with a 16mm magnetic film reproducer which carries a four-language soundtrack. A selector switch and headphones at each seat in the auditorium permit each auditor to select the desired language.

Simultaneous Theater Reproduction of Four Languages

LORIS M. GARDNER, *Edgerton, Germeshausen & Grier Inc., Las Vegas, Nev.*

Presentation of the scientific films which were prepared for the Atoms for Peace Conference at Geneva required multilingual sound. In order to provide a sophisticated performance, a four-theater complex was planned to present each film with simultaneous sound in the four official languages. Planning which led to the selection of the method is discussed. The parameters which controlled the selection of the gear are defined and the operation of the theaters during the conference is described.

International Use of Educational Films

MIGUEL PEREYRA, *Telesistema Mexicano S.A., Mexico City*

Certain questions are considered in an attempt to establish technical criteria for the production of educational films for international use. Among them: Is there a relationship between a thought and its image? Why do people like motion-pictures and television? The concept of "The Camera Setup: An Adjective for the Images" is examined. Practical suggestions for television programming and film production are given. The attitude of Spanish-speaking countries toward these problems is explained.

THURSDAY AFTERNOON

1:30 TELEVISION FILM TECHNIQUES

Standardized Gray-Scale Characteristic for Vidicon Telecine

L. J. MURCH, *Canadian Broadcasting Corp., Toronto, Ont., Can.*

The need for standardizing the gray-scale characteristic of a telecine chain is discussed. Factors which influence this characteristic are investigated and a standard characteristic is chosen. Finally, suitable test material is developed to set up and maintain the standard characteristic which is subsequently used for evaluating the suitability of films and slides for television reproduction.

Density and Exposure Control for Television Films

HAROLD WRIGHT, *Canadian Broadcasting Corp., Toronto, Ont., Can.*

A system for making 16mm film for television broadcasting is described. Two main objectives are achieved: (1) predictable vidicon telecine output transmission signals from visual material; (2) tone-scale matching of TV live studio and film materials for smooth integration of the two. The system is based on the establishment and maintenance of standardized characteristics for the telecine reproducer, the negative film process, the printing operation and the positive film process. ASA film ratings are not used. Instead scene element luminances are measured by an electronic spot photometer and related to *f*-stop settings and telecine output voltages by simple calculator wheels. All printing is done at the same printer light setting. The system permits accurate control of tonal scales, lighting key and mood.

Constant-Density Laboratory Process for Television Film

RODGER J. ROSS, *Canadian Broadcasting Corp., Toronto, Ont., Can.*

Requirements are outlined for a negative-positive laboratory process to obtain predictable waveforms at the output of a cali-

new horizons for dim light photography and television...

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40MM FOCAL PLANE

Super-Farron—an ultra high speed photographic objective having extremely fine correction over an unusually wide flat field. The advantages of its photographic speed of T/1.0 for operation under adverse light conditions are evident. It is available with standard infinity correction for direct photography, and it can be supplied corrected for 16:1 or 4:1 conjugates for special purposes. The Super-Farron is eminently suitable as an objective for Image Orthicon television cameras or for special 35mm photography.

Technical data available on request
Specify Engineering Report No. 327

Pat. No. 2,846,923

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brated telecine camera chain for measured luminance of scene elements. By taking advantage of the inherent reproducibility of the photographic process, a constant density and density difference system may be established using conventional processing and printing equipment and materials. Techniques are described for controlling the output of processing machines (of the Houston Fearless type), which are particularly applicable to smaller laboratories associated with TV broadcasting agencies. Statistical analysis of sensitometric control strips is employed to evaluate processing reproducibility; and chemical analysis of bromide content provides sufficient information to maintain image-forming conditions, when the replenishers for negative and positive developers have the same composition as the starting solutions, and are added directly to processing machine tanks. Tolerances that may be achieved in the practical operation of a system of this type are given.

MPO Infrared Matte Process

ZOLI VIDOR, *MPO Television Films, Inc., New York*

Technique of the Visual Squeeze

ROBERT BERGMANN, *Transfilm, Inc., New York*

The various elements that compose the "squeeze" commercial are described and also: how they are assembled, as compared with present procedures in standard live action and animation departments; personnel; and differences in approach, cost and completion time from standard film commercials. Elements of audio track which are considered include music, effects, voices and style of copy. Picture elements include number of scenes, animation effects, cutting and transitions.

Production Techniques of an Effective Television Newsfilm Public Relations Program

HOWARD BACK, *Chrysler Corp., Detroit*

Aspects of production of public relations newsfilm are con idered: coverage problems, kinds of laboratory service, editing and script techniques, and distribution methods. Chrysler Corporation's experience in this work is reviewed and general principles applicable to any similar operation are set fourth. Examples of recent public relations newsfilm material will be screened.

FRIDAY MORNING—MAY 8

CONFLUENT, from Havana and Miami: at press time, advice from Goar Mestre, President of CMQ Radio-Central, Havana, and Norman Bean of WTVJ, Miami, is that at least part of today's sessions will be jointly staged by connecting television.

9:00 TELEVISION FACILITIES

A Program-by-Program Billing System for Pay TV

K. A. SIMONS, *Jerrold Electronics Corp., Philadelphia*

Among the proposed methods for providing pay television, distribution by cable has several advantages. It does not come into conflict with licensed TV broadcasting and it does provide an additional service with its own channel space. It also provides the possibility of a return circuit between the consumer and the program originator. A system is described for using this return circuit to provide billing information. The system records during each program the identity of each receiver accepting it.

The Performance of Television Camera Lenses

GORDON HENRY COOK, *Taylor, Taylor & Hobson, Leicester, England*

It is well-known that optical aberrations are unavoidable in lens systems and that the suitability of a lens for a particular application is dependent on the extent of these aberrations and the manner in which they are balanced. The optical requirements for television can be well defined and it is worthwhile to design lenses specifically for television purposes. The advantages so obtained can only be expressed qualitatively by test methods which are based on these special requirements.

Gamma-Radiation-Insensitive Television Camera Lenses

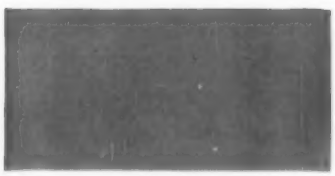
JOHN D. HAYES, *Bausch & Lomb Optical Co., Rochester, N. Y.*

Vidicon and image-orthicon TV camera lenses have been designed to utilize only those "non-browning" optical glasses especially developed to maintain their transparency in gamma-radiation fields. These lenses have focal lengths ranging from 18mm to 152mm. Optical and mechanical characteristics and performance test data are discussed.

Educators . . .

- Make sure you get the most out of your 16mm sound films
- Use the standard tests your own projector repairman uses
- Measure your projector's performance yourself with the . . .

16mm SOUND-SERVICE TEST FILM



- Points up both projection and sound troubles
- Instruction booklet supplied with the film
- Test instruments are not required. Write . . .

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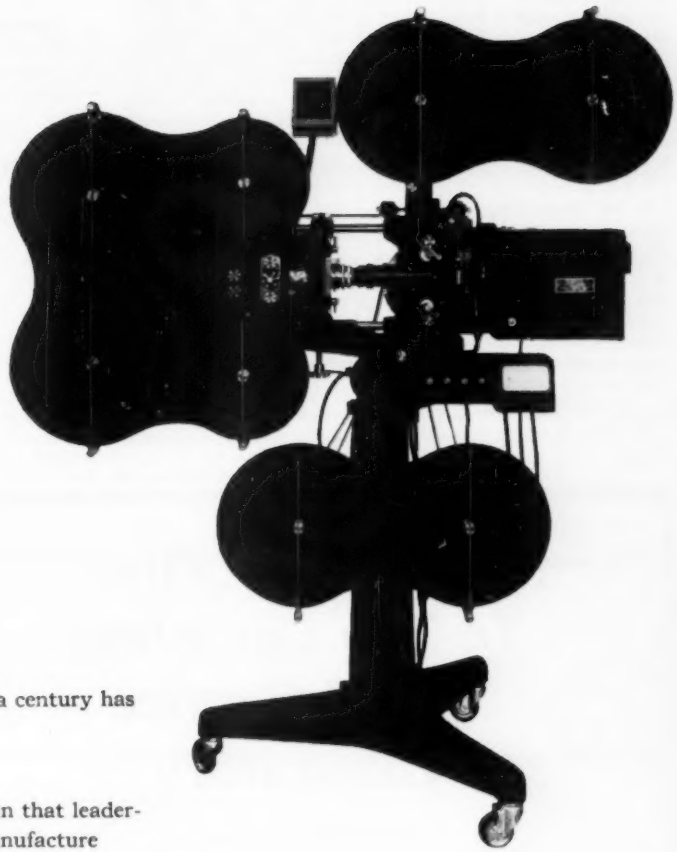
DEPUE

Optical Reduction Printer



The Depue Reduction Printer has been a leader and pioneer in the film printing business, and for more than a quarter of a century has served the industry and laboratories—and served them well!

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A New Approach to Balanced Audio Levels in Television

ROBERT B. MONROE, *CBS Television Network, New York*

For some time, television viewers have registered complaints that portions of TV programs are sometimes unpleasantly loud. In an effort to present TV programs to the public in the most pleasing manner possible, the CBS Television Network recently completed a new study of audio volume levels. This new study was for the express purpose of fully exploring the reason for these complaints. Findings of the study are presented and a new approach to the problem of achieving balanced audio levels is discussed.

Improving the Performance of Television Intercommunication Systems

A. PIERCE EVANS, JR., *CBS Television Network, New York*

Television studio and field cameras and associated equipment usually include telephone-type communication stations. These stations provide satisfactory communication between two points but have substantial shortcomings in output level and sidetone characteristics when integrated into the type of multi-station conference system commonly used in television studios. A transistorized device has been developed to replace the anti-sidetone transformer in existing interphone stations. Features include amplified receiver level and a sidetone compensation characteristic designed specifically for multi-station television interphone systems. Adequate output level is provided to permit operation under conditions of severe ambient noise.

CBS Self-Normalling Video Jack

CHARLES J. NEENAN, *CBS Television Network, New York*

A self-normalling video jack which replaces the plug-normalling jacks currently employed in video systems has been developed by CBS Television Network Engineering. The jack, now in full-scale operation, makes normalling plugs and terminating plugs unnecessary, as self-contained switching contacts and terminating resistors perform these functions. The self-normalling jack and its application are discussed.

Russian TV Today — Color and Monochrome

J. R. POPKIN-CLURMAN, *Telechrome Mfg. Corp., Amityville, N.Y.*

FRIDAY AFTERNOON

1:30 TELEVISION RECORDING

A Progress Report on Video-Tape Standardization

A. H. LIND, *Radio Corp. of America, Camden, N.J.*

The SMPTE Video-Tape Recording Committee has been working since its initial meeting in June 1958 on items requiring industry standardization in order to insure interchangeability of recorded video tapes. A list of pertinent items was prepared and tasks assigned by the Chairman. The list includes tape dimensions, tape reels, tape track dimensions; audio, control and cue track standards; monochrome and color signal characteristics; tape leaders; standard tapes; and tape splicing. This report covers the current status of the Committee's work.

Transient Response Considerations in Videotape Recording

ROGER HIBBARD and HAROLD WALSH, *Professional Products Div., Ampex Corp., Redwood City, Calif.*

Signal-handling techniques currently used in Videotape recording are considered, both theoretically and experimentally, as transmission elements in a TV system. The factors which determine the response characteristics, such as amplitude response, phase response, overshoot, and signal-to-noise ratio, are discussed. Experimental data leading to a more rigorous analysis of the signal system than has previously been possible are presented.

Extension of Bandwidth in Videotape Recording

CHARLES P. GINSBURG, *Video Engineering Dept., Ampex Corp., Redwood City, Calif.*

The efficiency of magnetic tape as a picture storage medium is a direct function of the information packing density and the frequency response of the recording system. Improvements in heads, tape and the signal system have made it possible to achieve a bandwidth considerably greater than that needed for monochrome and color television. The techniques used and the results obtained are described.

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Tentative Schedule of Committee Meetings

Tuesday, May 5

12:15 P.M. Luncheon Meeting — Study of Bylaws Revisions
12:30 P.M. Dutch Treat Luncheon Meeting—Public Relations Advisory Committee
2:30 P.M. Section and Student Chapter Officers
4:30 P.M. Association of Cinema Laboratories, followed by dinner, the Rosewood Room

Wednesday, May 6

10:30 A.M. Publications Advisory Committee
12:15 P.M. Editorial Luncheon
1:30 P.M. Papers Committee
2:30 P.M. Board of Editors

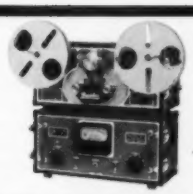
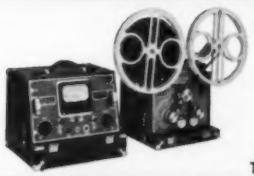
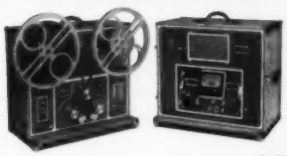
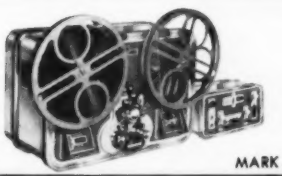
The following Engineering Committees will meet during the week:

Film-Projection Practice
Instrumentation and High-Speed Photography
Laboratory Practice
Screen Brightness
16 & 8 mm
Sound

The schedule will be listed in the Convention Program; and meeting notices will be mailed to Committee members at the first of April.

*How to select a recorder to start your MAGNASYNC-MAGNAPHONIC SOUND SYSTEM

Sound Equipment Checklist

		LIGHTWEIGHT	MEDIUM WEIGHT	16 MM FILM	17½ MM FILM	35 MM FILM	REWIND	FOOTAGE COUNTER	POWER AMPLIFIER	MONITOR SPEAKER	TORQUE MOTORS	PLUG-IN AUDIO	PUSH BUTTON CONTROL	REMOTE CONTROL	SLIDE-WIRE POTS	FILM MONITOR	SYNKINETIC MOTION	PLUG-IN HEADS
 X-400	When lightweight portability is a **must** the 27 lb. X-400 Type 1 is the answer! Another reason so many producers choose this machine is that it is genuinely professional, and yet, surprisingly economical! From $985.	X		X			X	OPTIONAL	OPTIONAL	OPTIONAL						X	X	OPTIONAL
 TYPE 1	The Type 1 is a miniaturized version of the Type 5. Low power consumption and extreme portability has made this 39 lb. unit a popular selection for remote location production by leading professional motion picture studios. From $1360.	X		X	X		X	X	X		OPTIONAL	X				X	X	OPTIONAL
TYPE 15	The X-400 Type 15 is designed for the man who wants everything in one case . . . playback amplifier, monitor speaker, footage counter and torque motors. You can be proud to have this machine represent you on any sound stage! From $1385.		X	X			X	X	X	X	X					X	X	OPTIONAL
 TYPE 5	The most popular magnetic film recorder in the world is the Type 5! With this unit and all its operational conveniences, you are definitely in the "major league." The Type 5 owner always starts his pictures with a special feeling of confidence in the realization that he has allowed no compromise in the selection of equipment. From $1570.		X	X	X	X	X	X	X	X	X	X				X	X	OPTIONAL
 MARK 1X	There is nothing on the market that compares with the remarkable Mark 1X. This unit is in a class by itself . . . with push-button remote controlled relay functions, plug-in audio elements and all the "extras" that make for flawless recording under the most adverse conditions. From $2145.		X	X	X	X	X	X	X	OPTIONAL	X	X	X	X	OPTIONAL	X	X	X

**Regardless of the model you select, you can always depend upon equipment with the "Magnasync-Magnaphonic" label . . . equipment made by the international leaders in the design and manufacture of quality magnetic film recording systems.*

MAGNASYNC — Magnaphonic SOUND SYSTEM

Write, wire or phone

MAGNASYNC MANUFACTURING CO., LTD.

5546 Satsuma Ave., North Hollywood, California • STanley 7-5493 • Cable "MAGNASYNC"

DEALERS: **CHICAGO,** Zenith Cinema Service, Inc.; **LOS ANGELES,** Birns & Sawyer Cine Equipment; **NEW YORK,** Camera Equipment Co.; **SAN FRANCISCO,** Brooks Camera Co.; **BELGIUM,** Brussels, S.O.B.A.C., S.A. (Societe Belge D'Applications Cinematographiques); **BOLIVIA,** La Paz, Casa Kavlin; **BRAZIL,** Rio de Janeiro, Mesbla, S.A.; **CANADA,** Toronto, Ontario, Alex L. Clark, Ltd.; **DENMARK,** Copenhagen, Kinovox Electric Corp.; **ENGLAND,** London, W-1, Delane Lea Processes, Ltd.; **HONGKONG,** Supreme Trading Co.; **INDIA,** Bombay, Kine Engineers; **ITALY,** Rome, Reportfilm S.R.L.; **JAPAN,** Tokyo, J. Osawa & Co., Ltd.; **MEXICO CITY,** D.F., Henri A. Lube; **PAKISTAN,** Karachi 3, Film Factors Ltd.; **SWITZERLAND,** Zurich 7/53, Rene Boeniger; **THAILAND,** Bangkok, G. Simon Radio Co., Ltd.

Featuring our new mixing consoles and consolettes at the SMPTE Convention, Miami Beach, May 4–7, Booths 42–43

The Mixed Blessings of the Video-Tape Recorder

SIDNEY V. STADIG, *Westinghouse Broadcasting Co., Cleveland, Ohio*

The video-tape recorder, acquired by Station KYW-TV in April 1958, brought with it a whole new set of problems and opportunities, not only in Production and Engineering, but also in the Sales Department. Disadvantages include maintenance, length of rehearsal and tape time, cost accounting, pricing, bookkeeping necessary to keep track of commercial takes, and the problem of small reels. Advantages include greater productivity and efficient use of studio crews, two-camera commercials and programs during time periods that would not otherwise be available because of lack of space, equipment or personnel, and better client and agency relations.

Methods of Recording Color Television on Magnetic Tape

CHARLES E. ANDERSON, *Ampex Corp., Redwood City, Calif.*

Recording of color television on magnetic tape has been accomplished. The system used was designed to accommodate commercially available recorders. If both color system and magnetic recorder could be designed together, or if the recorder could be matched to the color system, many possibilities for improvement present themselves. Methods that have been tried and others that have been suggested are described.

Operational Conveniences in the RCA TRT-1A Television Tape Recorder

A. H. LIND, *Broadcast and Television Equipment Div., Radio Corp. of America, Camden, N.J.*

The new production-model RCA Television Tape Recorder features advances in operational facilities and performance capabilities, including: built-in instrumentation for monitoring and maintenance functions; an added independent audio track for cuing, control or allied purposes; provision for master erasing of tape on a selective basis; and a new adjustment for video head quadrature. A general description of the recorder is given.

New Horizons for Television Tape

ROSS H. SNYDER, *Professional Products Div., Ampex Corp., Redwood City, Calif.*

The initial applications of television tape to network delay and TV commercial inserts fired the imagination of TV producers with the idea of tape syndication as a supplement and perhaps as an eventual replacement for photographic film used in production and for TV release. Prospects for this development depend upon technical and economic considerations. Present technical capabilities and limitations are discussed and future possibilities suggested. Non-television applications within the capabilities of the TV tape recorder are mentioned.

A Mobile Videotape* Recording System

J. BYRNE HULL and H. G. HUMMEL, *Professional Products Div., Ampex Corp., Redwood City, Calif.*

The system design and constructional layout problems of a special bus containing a Videotape Recorder, two camera chains, signal generating equipment, director's console, monitoring facilities and self-contained power supply are described. System performance and accessory requirements are considered in detail. Various concepts in the use of the Videotape Cruiser are discussed, especially with regard to the advertising and motion-picture industries. (*TM Ampex Corp.)

SATURDAY—MAY 9

SPECIAL POST-CONVENTION TOURS

10:00 A.M. Tour of Patrick AFB Motion Picture Laboratory

1:30 P.M. Tour of Cape Canaveral

(See Final Program for further details.)

DO YOU REQUIRE PARTS PRODUCED TO THE ACCURACY OF THIS GENEVA STARWHEEL?
ACTUAL SIZE
REGISTER: Slot to Slot — .0001
Center to Center of Adj. Radii — .0001
TOLERANCES: Slot Width — .00005
Radii Size —.0001
Radii Location — .0001
SURFACE FINISH: Slots — 8 RMS
Radii — 16 RMS
Shaft — 4 RMS
Critical work of this nature has been the specialty of LaVezzi for over 50 years. The requirements you have for small high precision parts including difficult operations, fine finishes, critical deburring, etc., can be handled efficiently by LaVezzi. We are anxious to serve you and invite your inquiries and quote requests. Write today for illustrated brochure.
LaVezzi MACHINE WORKS
4635 WEST LAKE ST., CHICAGO, ILLINOIS

Ladies Program at Miami Beach

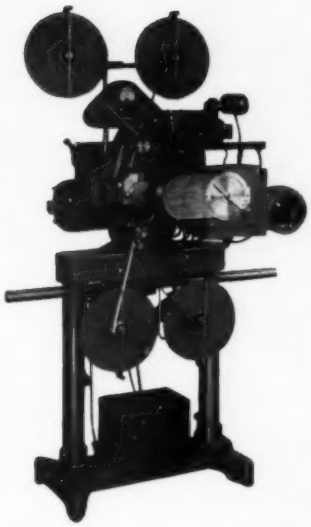
A Cruise in Quiet Waters

An enchanting and dreamlike cruise through quiet waters is on the agenda for the lucky ladies of the 85th. Beginning after breakfast on May 5, when a luxurious cruise ship leaves from a nearby dock, the world of science will seem remote and unreal as the "yacht-type" cruiser steams among the residential islands, where the lush tropic vegetation has been tamed by architects and gardeners.

At noon the boat docks at the Ocean Ranch Restaurant for a luncheon appropriate to the enchanting setting. In the afternoon the cruiser will arrive at Vizcaya, a magnificent Italian-type palace surrounded by impressive gardens. All this magnificence was once the James Deering estate and is now the Dade County Museum. The cruise ends before 5 o'clock. The entire trip including luncheon will cost $5.00.

Besides the Society's Get-Together Luncheon on Monday, other "funtype" things to do include the traditional Wednesday evening cocktail party, banquet and dance. To some, the best part of the Convention will be the long hours spent enjoying the sea, the sun and the sand, with their enjoyment enhanced, perhaps, by wearing becoming swim suits and getting a long look at what others are wearing.

New High Speed PETERSON Model 16-C-100



Single Head 16MM Continuous Contact Picture and Sound Printer

The NEW PETERSON 16MM CONTINUOUS CONTACT PRINTER has been designed to produce quality print at a new printing speed of 144 feet per minute.

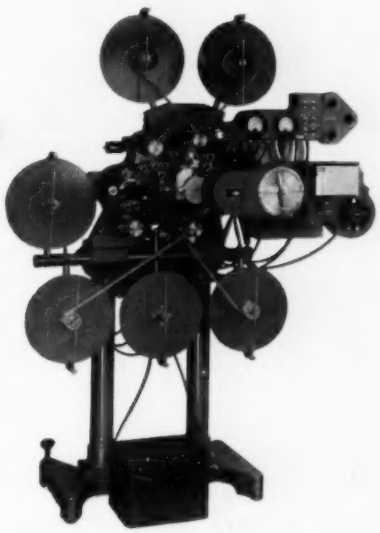
A new type of aperture and film printing gate has been designed.

A precision contact roller is used rather than a shoe.

A new type of film support is used to carry the film edge of the sound side over a rolling drum, whereby perfect contact is obtained between the negative and positive print.

This printer is available with either a Semi-Automatic Light Control, or with a Fully Automatic Light Control.

New PETERSON Model 16-C-60



Double Head Contact Printer

The NEW MODEL 16-C-60 PETERSON DOUBLE HEAD CONTACT PRINTER prints sound and picture simultaneously, from separate negatives, in one operation.

Equipped with Semi-Automatic Light Control.

Available in 16MM or 35MM.

Can be equipped with Fully Automatic Light Control Shutter and built-in Automatic Fade Unit.

Produces quality print at a new speed of 72 or 144 feet per minute. Two-speed drive motor is used.

Film take-up flanges have individual torque motors. Feed-out and take-up flanges will hold 1200 foot film rolls.

MOTION PICTURE PRINTING EQUIPMENT CO.
Mfrs. of Optical and Continuous Printers and Accessories
8107 NORTH RIDGEWAY AVENUE • SKOKIE, ILLINOIS

Write today for further description and prices.

Membership Committee

The activity of SMPTE Membership Committees is sporadic, according to 1958 National Membership Chairman Edward Warnecke. In a recent report to the Board of Governors, Warnecke indicated that some Sections are rapidly acquiring new members through the efforts of dedicated membership chairmen and their aides, while other Sections are not making comparable progress.

Cited by Warnecke as one of the hardest working membership chairmen was Harry J. Lehman, President-Producer, Cine-Tele Productions, Hollywood, whose efforts have added 82 new members to the roster of the Hollywood Section. Mr. Lehman even acquired a new applicant from Alaska on the very same day that Alaska was declared officially the 49th State of the Union.

Others whom Warnecke cited for their outstanding work on Membership Committees are:

Jerome C. Diebold, Exec. Producer, Wilding Picture Productions, Chicago, who brought 29 new members into the Chicago Section.

Alan C. Macauley of S.O.S. Cinema Supply, Hollywood, whose efforts resulted in 21 new members for Hollywood.

Norman Berger, Movielab Color Corp., New York, who brought 20 new members into the New York Section.

Joseph T. Dougherty, E. I. du Pont de Nemours, New York, 17 new members for the New York Section.

Harry N. Jacobs, American Broadcasting Co., 16 new members for the San Francisco Section.

Donald W. Dixon, Canadian Kodak Co., Scarborough, Ontario, 12 members for the Canadian Section.

John W. DuVall, E. I. du Pont de Nemours, Hollywood, 7 new foreign members.

The Nashville Section, just established last year, was cited for its outstanding work, and a great deal of activity is expected from that Section this year.

The new Boston Section, established in February, is also expected to grow rapidly.

Increased interest in educational television and motion pictures, electronics and high-speed photography is expected to enlarge possibilities for expanded membership in all Section areas this year, according to Kenneth M. Mason, Eastman Kodak Co., Chicago, who is this year's National Membership Chairman.

Association of Cinema Laboratories

Cinema Laboratories 1959, a 60-page directory of motion-picture laboratories throughout the world, is published by the Association of Cinema Laboratories. The directory lists names and addresses of 248 laboratories, together with the services offered. The listing includes 113 laboratories in 33 foreign countries, and 135 laboratories in the United States, including one in Puerto Rico. Information contained in the directory is that received from a questionnaire which was sent to more than 500 organizations. Members of the Committee responsible for preparation and publication were George W. Colburn, *Chairman*, James Wassell, Kern Moyse and Kenneth Mason.

At its annual meeting, February 12, in New York City, the Association elected the following officers: President, *George W. Colburn* of Geo. W. Colburn Laboratory, Inc.; Vice-President, *G. Carleton Hunt* of General Film Laboratories Corp.; Secretary, *Dudley Spruill* of Byron Inc.; Treasurer, *Kern Moyse* of Peerless Film Processing Corp.

New ACL Directors are: James A. Barker, Capital Film Laboratories, Inc.; Robert F. Burns, Houston Color Film Labs, Inc.; Spencer W. Caldwell, S. W. Caldwell Ltd.; Louis Feldman, Du Art Film Laboratories, Inc.; Reid H. Ray, Reid H. Ray Film Industries, Inc.; Byron Roudabush, Byron, Inc.; Leon Shelly, Shelly Films Ltd.; William H. Smith, Lakeside Laboratory; Sidney P. Solow, Consolidated Film Industries; and Floyd Weber, Mecca Film Laboratories, Inc.

Single copies of *Cinema Laboratories 1959* cost $1.00. Large-lot prices and information about the Association are also available from the ACL Secretary, *Dudley Spruill*, c/o Byron, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D. C.

"FAR-SIGHTED" MIRROTEL LENSES CAN

Wollensak Mirrotel Lenses (20", 40" and 80") extend the capabilities of high speed motion picture photography in tracking missiles and in radar boresight applications. They deliver images of excellent resolution and contrast.

ADVANTAGES • Because of mirror optics (the light path is "folded" three times within the system) the lenses are short and lightweight . . . are free from chromatic aberration, coma, astigmatism, distortion . . . are most stable under extreme environmental conditions. Invar rod mounting permits high boresighting accuracy.

CAMERAS • Mirrotel lenses are extensively used with a wide variety of cameras, such as FASTAX, FASTAIR, Flight Research IV-C, Automax, Mitchell (16mm, 35mm), Cameraflex, Eyemo and TV cameras.

SPECIAL FEATURES • Mirrotel Lenses can be supplied with reticle printers, fiducial markers, continuous focusing, counters, reflex finders, radiation shields, custom mounting bases for lens and camera (illustrated), neutral density and color filters.

If you need extra long focus lenses of unusual characteristics, **WRITE** Dept. FXL for Mirrotel catalog M-1 and prices. Inquiries invited.

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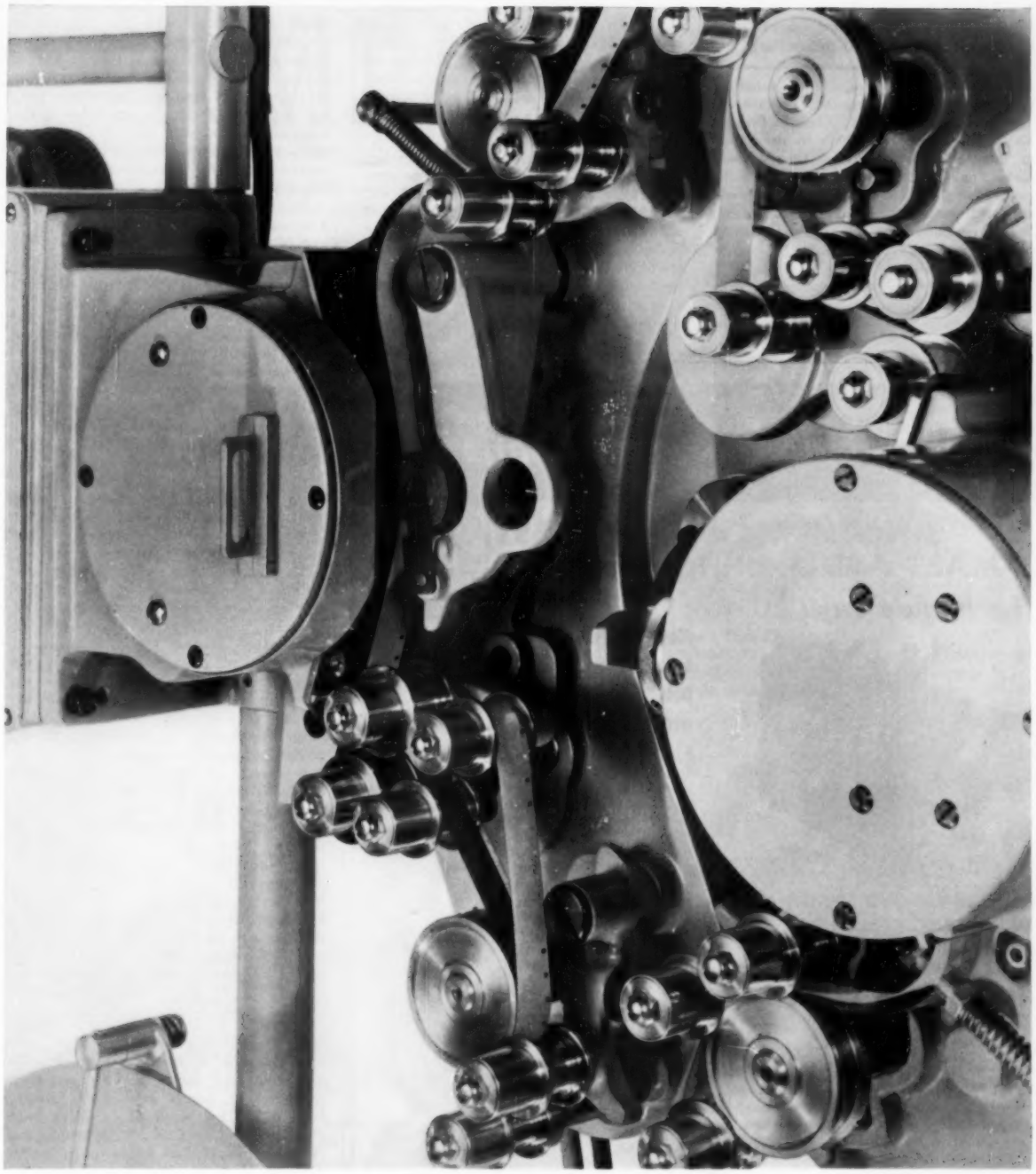
OPTICAL COMPANY • ROCHESTER 21, N. Y.

Come and visit us at Booth 45



Now available: higher fidelity sound tracks, more light for color printing. The newly improved Design 6190 Bell & Howell sound head is a vast improvement over all existing types. It delivers higher fidelity sound tracks and provides more available light for color printing. And because it makes possible single-pass printing, it steps up your output while reducing costs. Installation is simple on any 16mm Bell & Howell printer. Also available in a new 35mm version—the Design 6210. Write Professional Equipment Division, 7185 McCormick Road, Chicago, Ill. **Bell & Howell**

Fourth International Conference on Motion-Picture Engineering

The professional organization of motion-picture engineers in France (Commission Supérieure Technique du Cinéma Français) is sponsoring the fourth in the series of international conferences on motion-picture engineering which have been held in Europe since 1954. This year's conference will be held June 10–12, in Paris. Previous conferences in the series took place in Paris in 1954, Rome in 1955, and Warsaw in 1957.

The general theme of the conference will be the orientation and future of theatrical motion pictures, and there will be five main topics for which technical papers are invited: (1) new developments in wide-screen and wide-film processes; (2) progress and developments in light sources; (3) sound systems; (4) automation in projection systems; and (5) theater design and construction.

Secretarial services for the conference are being supplied by the Commission Supérieure Technique du Cinéma Français, 92 Champs-Elysées, Paris 8e, and detailed information can be obtained from the Secretary, Jean Vivié, at that office. A few copies of the advance program of the conference, with application forms for those who wish to submit technical papers, are available at SMPTE headquarters in New York. Mr. Vivié, who has long been prominent in France as a most active participant in professional motion-picture engineering affairs, is an SMPTE member of many years standing and since 1957 has aided the Society as chairman of the Continental Division of the European Advisory Committee as well as being the representative for France on the Papers Committee.

During the conference it is planned that a meeting will be held for further discussion of the organization and bylaws of the International Union of Motion-Picture Engineering Societies (Union Internationale des Associations Techniques Cinématographiques — UNIATEC) which was established at the Warsaw conference in 1957. In addition to delegates from the Societies that are already members of this body, observers from other organizations will be invited to participate in this meeting, and it is probable that SMPTE will have some observers present.

Membership in IRE Professional Groups has been facilitated for SMPTE members under a recently announced Affiliate Plan of the Institute of Radio Engineers. According to this plan, members of selected technical societies may become affiliated with, and receive the publications of, specified Professional Groups without being required to become full IRE members, upon payment of professional group dues plus $4.50. Open to SMPTE members is the Professional Group on Information Theory (PGIT). An invitation has also been extended by the Professional Group on Engineering Writing and Speech.

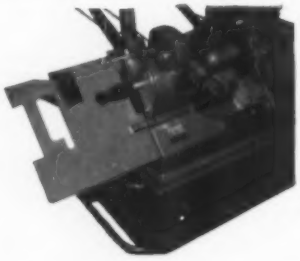
A session of special interest will be conducted by PGEWS on March 23 at the Waldorf-Astoria Hotel, New York, during the IRE National Convention. Session Chairman is E. K. Gannett, Managing Editor, *Proceedings of the IRE*. The program includes papers on "Using the Psychological Approach in Scientific Writing," by J. L. Kent; "An Effectual Approach to an Orally Presented Paper," by I. J. Fong; "Read Your Speech," by E. W. Still; and "Subjectivity vs. Objectivity in the Technical Report," by S. A. Cohen.

Techniques of film editing are demonstrated and analyzed in two films produced by American Cinema Editors, Inc., 6772 Hollywood Blvd., Hollywood 28. A series of films on editing techniques, of which these two are the first, is planned. The organization, which was formed "for the purpose of maintaining and improving the technique of film editing, also to promote a greater knowledge and appreciation of motion pictures in general and film editing in particular," has arranged for purchase of these films on a non-profit basis for educational purposes.

The first film, *Basic Principles of Film Editing*, runs for about 8 min. It is of general interest and shows a dramatic scene without editing and then shows how editing enhances the scene's dramatic values. It is priced at $25.00 plus postage. The second film, *Values and Interpretations*, which runs about 30 min, shows all the scenes of various angles as shot for a

OUR EXPERIENCE IS YOUR KEY TO
SERVICE & DEPENDABILITY

ANOTHER CAMART FIRST!
CAMART ADD-A-UNIT EXTENSION PLATES
For Moviola Series 20
(U. S. Pat. Pending)

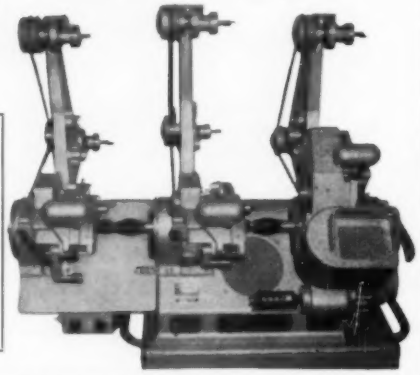


Now add a third sound head to your two head Moviola using this easy as A-B-C attachment:

- ADD-A-UNIT for your sound effects.
- ADD-A-UNIT for your musical background.
- ADD one or two extra to your two-head Moviola.
- ADD-A-UNIT installs units in a few minutes.
- ADD-A-UNIT requires no drilling or tapping.
- ADD those needed extras.

AND YOU CAN ADD FOURTH AND FIFTH SOUNDHEADS JUST AS EASILY! MAKE ANY COMBINATION OF 16mm AND 35mm OPTICAL-MAGNETIC SOUND HEADS.

Add excitement to your films.

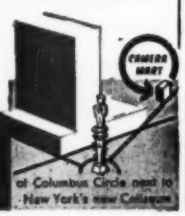


CAMART ADD-A-UNIT EXTENSION PLATE is complete with extra belt guard, flange, flexible coupling assembly, separate volume controls, for each head, and amplifier attachments (for Moviola Series 20 machines) . . .

$325.00 f.o.b. N. Y.

Separate soundheads or take-ups additional. Prices on request.

The original CAMART ADD-A-UNIT EXTENSION PLATE is available only at the Camera Mart, Inc. or their exclusive franchised dealers.



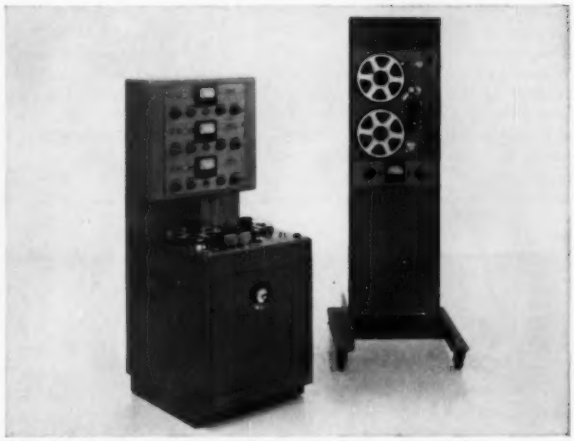
the CAMERA MART inc.
1845 BROADWAY (at 60th St.) NEW YORK 23 - PLaza 7-6977 - Cable: Cameramart
at Columbus Circle next to New York's new Coliseum

AMPEX

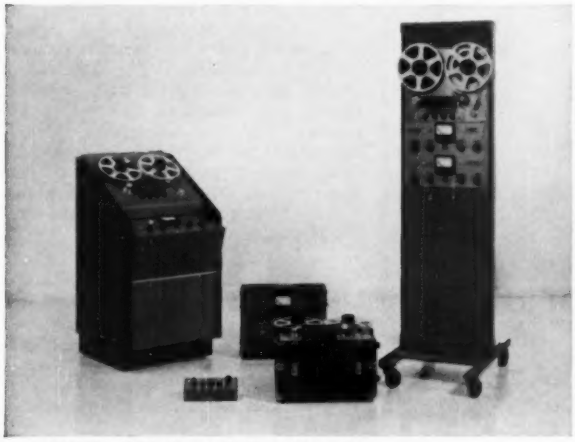
World Leader in Precision Magnetic Tape Recording Instruments

Ampex Tape Recorders are in service throughout the world in television and radio stations, and in professional sound recording studios . . . wherever finest quality is required.

VR-1000 *Videotape* Recorder*
First commercially available Videotape Recorder. Magnetically records what the TV camera "sees," in either black and white or color. Playbacks look "live."



MODEL 300 *Magnetic Tape Recorder*
Standard of the professional recording industry, it consistently delivers the finest in audio reproduction. Available in as many as 8 channels, in console and rack mounting.



MODEL 351 *Magnetic Tape Recorder*
First choice of the broadcasting industry. Features printed circuits and miniature tubes. Available in console, rack and portable models, with one or two channels. Sold by dealers.

MODEL 3200 *Magnetic Tape Duplicator*
High speed duplication, with superb fidelity, of recorded master tapes. Makes up to 10 copies at one time. Available with one, two or four channel heads.

Fully illustrated brochures, complete with specifications, are available on each recorder and the duplicator. Technical bulletins are also available on the following subjects: VIDEOTAPE RECORDING • VIDEOTAPE SPLICING • MULTI-CHANNEL RECORDING • MULTI-CHANNEL TECHNIQUES • Write for the copies you want, today.

Tenth Year of Leadership

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AMPEX CORPORATION
professional products division

*TM Ampex Corporation

dramatic sequence, and then shows three interpretations by different editors of how the sequence should be edited. It is priced at $55.00 plus postage. The films may not be rented but may be previewed for possible purchase upon payment of one-way postage. Showing of the films for admission charge or profit is prohibited.

A 20-session course in Sensitometry has been offered by the Dept. of Photographic Arts, Ryerson Institute of Technology, 50 Gould St., Toronto 2, Ont., as part of its Extension School Program. Enrollment in the course, which was initiated in the Fall of 1958, was originally limited to 40, but an enrollment of 59 was permitted by the Institute because of the unexpectedly large number of applicants. Even with the extended enrollment, a number of applicants were refused. The instructor is Leslie H. Holmes, a member of the Institute's regular teaching staff. He also teaches Commercial Photography, Photographic Chemistry and Motion-Picture Photography.

Millimeter Waves is the subject of the Ninth International Symposium of the Polytechnic Institute of Brooklyn, Microwave Research Institute, to be held March 31–April 2 in New York under the co-sponsorship of the Air Office of Scientific Research, U.S. Army Signal Research and Development Laboratory, Office of Naval Research, and the Institute of Radio Engineers. The Symposium is intended to highlight the present state of research in, and applications of, millimeter wave technology.

Scratches on Film

Irritate Audiences

Scratches are havens for dirt, and refract light improperly. On the screen, they mar the picture and may distract attention. If on the sound track, they produce offensive crackling.

Fortunately, scratches can almost always be removed — without loss of light, density, color quality, sound quality, or sharpness.

PEERLESS
FILM PROCESSING CORPORATION
165 WEST 46th STREET, NEW YORK 36, N. Y.
959 SEWARD STREET, HOLLYWOOD 38, CALIF.

The Motion Picture Research Council has installed a closed-circuit television system as part of a broad new research program to study the technical aspects of TV film production and transmission. The installation will be used to study and analyze such technical factors as the effects of lighting, photography, set construction, costuming and sound as they appear on black-and-white and color home receivers; and to investigate print density, contrast range, color balance, print standardization and associated problems in relation to broadcasting motion-picture films.

The setup includes 35mm, 16mm and slide projectors, a 3-vidicon color camera and other signal-processing equipment identical in design and performance to equipment used by the major TV networks and many independent broadcasters. Also included is a viewing room designed to typify viewing conditions in the average American home.

One of the main objectives of the program is to develop calibrating procedures and a test film which will facilitate production of uniform prints and thus reduce the need for attempts at quality control at the stations. Demonstrations of the system are being conducted for personnel of member companies.

Pictures Teach at Penfield, a film produced by Eastman Kodak Co., has been made to illustrate the role of audio-visual materials in elementary and secondary education by dramatizing the teaching methods used at the Penfield, N.Y., Central School District, where films, slides and film strips are integral parts of the curriculum. The story centers around the reactions of two students, brother and sister, to audio-visual instruction. The film, which runs 19 min, is available on free loan for showing to groups interested in education. A print may be scheduled by writing Audio-Visual Service, Eastman Kodak Co., Rochester 4, N.Y.

English for Foreigners is a television program produced by Wayne University in Detroit. It is designed to teach English to the large foreign-born Detroit population, using specially constructed audio-visual aids. These programs are broadcast from ETV station WTVS on Monday and Wednesday of each week at 7:30 P.M.

The Committee on International Nontheatrical Events (CINE) has selected films in the categories of Industrial Relations, Advertising, Public Relations and Sales to represent the United States at the Festival of Films in the Service of Industry at Harrogate, England, April 21–24. The films are: *Speaking of Words*, sponsored by Pan American World Airways, produced by Henry Strauss & Co., New York; *Silk*, sponsored by the International Silk Assn. (U.S.A.) Inc., produced by Riviera Productions, Los Angeles; *The Hope That Jack Built*, sponsored by National Assn. of Investment Companies, produced by Robert Lawrence Productions, New York; *The Production of USS Steel Sheets*, sponsored by United States Steel Corp., produced by Jam Handy Organi-

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Ideal for captions, legends, titles, art work for TV commercials. Can be used easily, needs no special skills. Aheres to most materials indefinitely. Comes in many type faces and sizes, and in a variety of colors.

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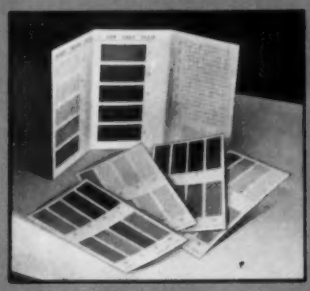
For Mitchell or CECO Erect Image Viewfinder. Allows cameraman to view through finder from 12 inches above or below normal viewing position. May be used when camera is above or below average height. Adjustable.



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Indicates how colors will reproduce in monochrome when photographed by film or TV cameras. Insures correct evaluation and choice of colors for desired effects.

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CECO offers the world's largest and most comprehensive line of professional cameras, accessories, lighting, editing, processing and animation equipment including: MAURER Products (Exclusive Distributor); Oxberry Animation Equipment; Cooke Speed Panchro Series II, Kinetal, Kinoptic, and Bausch & Lomb Baltar Lenses. Other products we carry are: Color Charts - Computers - Splicers - Exposure meters - Projectors - Screens - Marking pencils and pens - editors gloves - stop watches.

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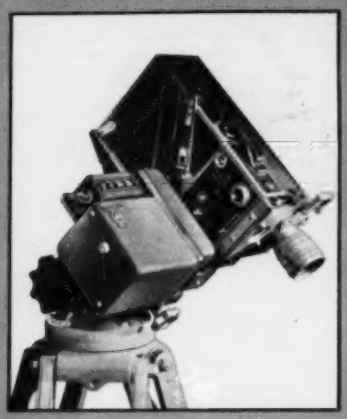

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zation, Detroit. *The Mayflower Story*, sponsored by Aero Mayflower Transit Co., produced by Paul Alley Productions, New York, will be sent as an "extra" as a symbol of British-American friendship.

Preliminary selection of films for the Harrogate Festival was handled by CINE's Business and Industry Subcommittee under the chairmanship of John Flory, Advisor on Nontheatrical Films for Eastman Kodak Co., assisted by Thomas W. Hope, Assistant Advisor.

Art in Film, an exhibition of the work of artists in the production of motion pictures, will be shown at Cooper Union Museum, Cooper Square, New York 3, Apr. 15–May 15. The exhibition was prepared and circulated by the Long Beach Museum of Art in California. It shows the work of designers and craftsmen in the studios of Metro-Goldwyn-Mayer, 20th Century-Fox and U.P.A. Pictures. Included in the exhibit are sketches for make-up and for individual scenes, original models of sets, costume designs, and other examples of artists' work. Collections of designs from a number of current motion pictures are included.

Space Talk, a 19-page booklet published by Republic Aviation Corp., Farmingdale, L.I., N.Y., contains definitions for 133 words and phrases used by astronautical scientists and engineers. Compound words (magnetohydrodynamics), scientific terms (parsec), and a few slang terms (auntie, meaning antimissile missile) are included. In the foreword, "Lets Get on the Moon Beam," William J. O'Donnell, Chief Engineer of Republic's Aircrafts and Missile Development, states, "If (the booklet) does nothing more than aid you in a better understanding of the news reports on missile, rocket and space activities, it will have served its purpose." The booklet is available without charge.

Walter J. Albersheim, formerly of Bell Telephone Laboratories, has joined the staff of Spencer-Kennedy Laboratories Inc., 1320 Soldiers Field Rd., Boston 35, Mass. As Chief Engineer, Dr. Albersheim will head engineering and development work, both in the instrument division and in the closed circuit and community antenna division. Co-author with Donald MacKenzie of the Society's Journal Award paper, "Analysis of Sound-Film Drives," (*Journal*, *37:* 452–479, Nov. 1941), Dr. Albersheim has published several other papers in the *Journal*. In addition to his Society membership, he is a member of the New York Academy of Sciences and a Fellow of the Institute of Radio Engineers.

Robert D. Shoberg has joined the staff of Beckman & Whitley Inc. as Camera Product-Line Manager and will have charge of the Dynafax Camera and the Magnifax Camera. Prior to his present appointment he was Sales Manager for Fairchild Data Devices. A member of the Society, he has been active on the High-Speed Photography Committee.

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Pontcanna Studios, situated in the midst of a wooded parkland about half a mile from the center of Cardiff, Wales, were designed to provide a natural, outdoor setting for filming live TV shows. Certain limiting factors, among the foremost the unpredictable climate of Great Britain, presented problems to which ingenious solutions were found. Constructed by TWW, Limited, Independent Television contractors for South Wales and the West of England, the outdoor stage of the studios was opened Aug. 16.

The preservation of a natural "woodsy" environment required on elaborate system of drainage and cable ducting. Six-inch fiber waterproofed ducting was used throughout the 300-ft ducting runs. Outlet boxes for sound and vision connections were disguised as garden seats and ornaments. In filming the first production, four Marconi Mark 3, 4½-in. image-orthicon cameras were used, one fitted with a Watson zoom lens (focal length 3 in. to 15 in.) mounted on a 20-ft platform. Other cameras used long focus-type lenses. Hidden microphones were employed throughout the working area, supplemented by bamboo pole booms for special close-ups. Sound cables were laid in a separate ducting system, and hum level was measured at better than −120 db unweighted, referred to 1 mw in 600 ohms over the whole of the 300-ft run.

Closed-Circuit TV Installations in Educational Institutions

Closed-circuit television was used in classroom instruction in 119 educational institutions during 1958 and a total of 133 systems had been installed, according to a survey conducted by the Joint Council on Educational Television, 1785 Massachusetts Ave., N.W., Washington 6, D.C. The report contains tables which summarize replies to a questionnaire sent early in 1958 to accredited institutions of higher learning and to secondary and elementary schools with closed-circuit installations. Class instruction over these systems ranges from first grade through college post graduate. It is noted that some of the equipment is used for instruction *in* television rather than instruction *by* television. Closed-circuit TV is also used for instruction and training purposes at 21 military installations.

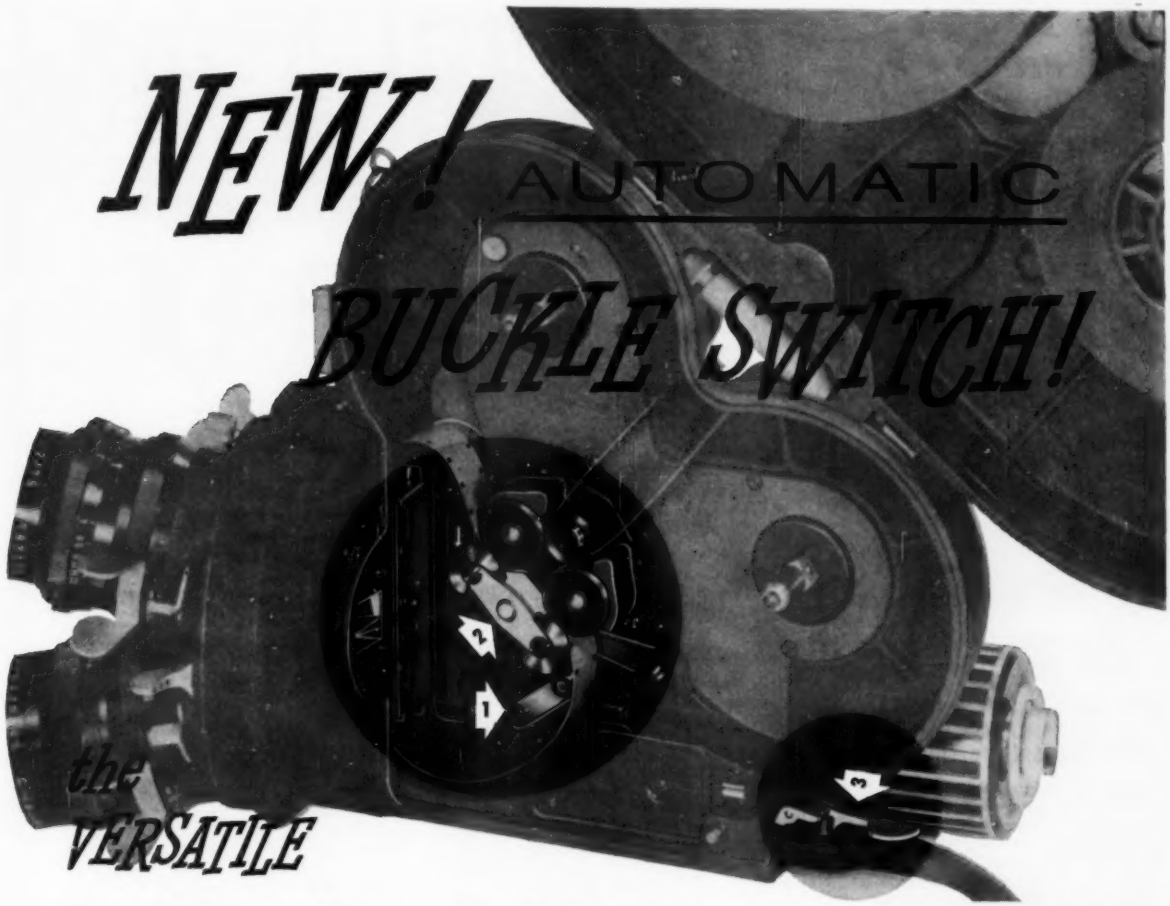
The report lists the school, college or university, the office or department responsible for TV operation; the originating points (studios, classrooms, laboratories); kind of equipment (orthicon, vidicon, film or slide chains); reception points (classrooms, laboratories); subjects taught, both the courses taught by closed-circuit and the courses in television. Other educational uses of television also are reported. Copies of the report are priced at 30 cents when several copies are ordered, but single copies are available without charge upon request to the Council.

SMPTE Test Films

Test films planned by the Society's technical committees and produced under the Society's exact supervision are available from the headquarters office at 55 West 42 St., New York 36. Catalogs containing brief descriptions of each film are obtainable on request.

Films are available in the following categories:

Television—Picture Only, Color or Black-and-White
CinemaScope
Visual 35mm—Picture Only
Magnetic—16mm Sound Only
Picture and Sound—16mm
Picture Only—16mm
Glass Slide—36mm



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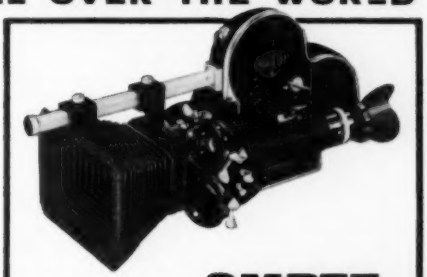

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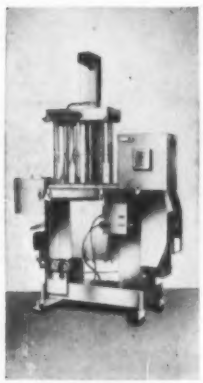

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section reports

In recent years reports from the Secretary-Treasurers of Sections have been published in the *Journal* soon after the meetings. In recent months the space available in the *Journal* has been insufficient for the task. The January and February *Journals* contained reports from many months past but still a large number of reports remained on hand; therefore, to bring the published record quickly up to date the many recent reports are abridged in the tabulation published below. The reports were supplied by:

Atlanta Section: WESLEY R. SANDELL, c/o Kodak Processing Lab., 4729 Miller Dr., Chamblee, Georgia
Canadian Section: RONALD E. RINGLER, c/o Dupont Co. of Canada, Ltd., Toronto, Ont.
Chicago Section: WILLIAM H. SMITH, Lakeside Lab., Box 2408, Gary 5, Ind.
Dallas–Fort Worth: PHIL WYGANT, 6021 Plants Ave., Ft. Worth 12, Tex.
Hollywood Section: CARL W. HAUGE, c/o Consolidated Film Industries, 959 N. Seward, Hollywood 38
New York: EDWARD M. WARNECKE, c/o Eastman Kodak Co., 342 Madison Ave., New York 17
Rochester Section: R. E. PUTMAN, 420 East Corey Rd., Syracuse, N.Y.; and RONALD E. CONNOR 35 Chatham Park, Rochester, N.Y.
San Francisco Section: RODGER L. WOODRUFF, c/o KRON-TV, 929 Mission St., San Francisco; and FRANK MANSFIELD, 57 Stoneyford Ave., San Francisco, Calif.

Section, Date and Place	*Program*
Canadian, Nov. 13, Cinesound Ltd., Toronto	"Anamorphic Lenses and Their Application in the 16mm Field" by *Arthur Chetwynd*, Chetwynd Films, Toronto "Microphone Techniques for Two-Channel Stereo" by *Tony Jamroz*, Northern Electric Co., Belleville, Ontario
Chicago, Nov. 10, Bell & Howell Co., Design Engineering Dept., Lincolnwood, Ill.	"International Standardization of Magnetic Sound on Film" by *Malcolm G. Townsley*, Bell & Howell Co., Chicago
Rochester, Nov. 21, Dryden Theatre, George Eastman House, Rochester	"Techniques for Visual Aids Production" by *Norman E. Salmons*, Director of Audio-Visual Services, Eastman Kodak Co., Rochester "Facilities Equipment and a System for Visual Aids" also by *Norman E. Salmons*
San Francisco, Nov. 10 (Joint meeting with Audio Engineering Society), San Francisco City College	Informal debate on stereophonic reproduction, led by *R. J. Tinkham* and *Ross Snyder*, Ampex Corp., Redwood City, Calif.
Chicago, Dec. 8, Argonne National Laboratory, Lemont, Ill.	"The Laboratory's Film Program" by *George W. Lindholm*, Argonne National Laboratory, Lemont, Ill. "Unusual and Exacting Film Techniques" by *Daniel S. Giroux*, Argonne National Laboratory, Lemont, Ill. "The Fast Reactor Program" a film produced by the Laboratory
Canadian, Dec. 16, Radio-Canada Bldg., Montreal	Tour of CBC's Montreal facilities, with a 45-minute film showing facets of CBC TV operations which could not be seen on the tour
Hollywood, Dec. 16, Walt Disney Studios, Burbank, Calif.	"A Colorvision Demonstration and Discussion" by *Lionel H. Wheeler*, Colorvision Inc., Los Angeles "A Personal Report of Current TV and Movie Activity in Mexico City" by *Sidney P. Solow*, Consolidated Film Industries, Hollywood "Ampex Videotape Recorders" by *Joe Roizen*, Ampex Corp., Culver City, Calif.
New York, Dec. 17, Carnegie International Endowment Center, New York City	"A Technique for Reducing Contrast for Special Purposes in Printing From Negatives of Normal or Excessive Contrast" by *Paul A. Kaufman, Ferdinand India* and *Robert M. Smith*, DuArt Film Laboratories Inc., New York City
Rochester, Dec. 18, Dryden Theatre, Eastman House, Rochester, N. Y.	"Fundamental Concepts in the Design of a Flying-Spot Store" by *R. W. Ketchledge*, Bell Telephone Laboratories
San Francisco, Jan. 13, KGO-TV Studios, San Francisco	"Technical and Production Techniques Used in Making Science Films" by *Ward Kimball*, Walt Disney Studios, Hollywood

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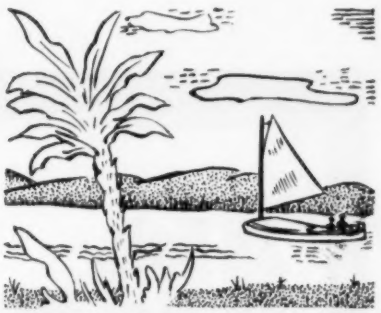

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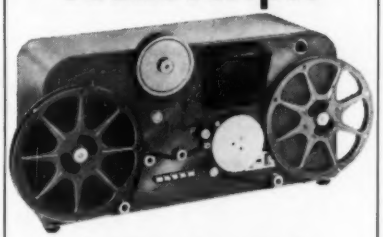

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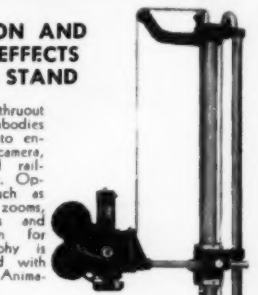

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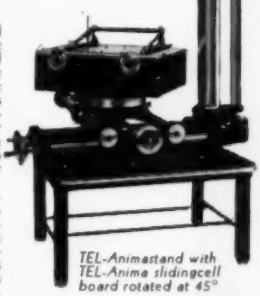

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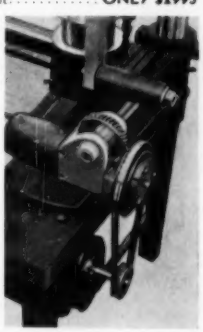

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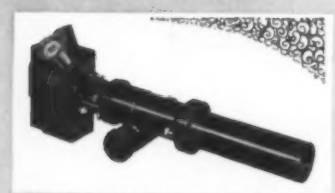

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Section, Date and Place	*Program*
New York, Jan. 14, Carnegie International Endowment Center, New York City	"The Future of Film in Television" a panel conducted by *Ethan M. Stifle*, Eastman Kodak Co., New York; *Joseph T. Dougherty*, E. I. du Pont de Nemours & Co.; *William Van Praag*, Van Praag Productions; *Clay Adams*, CBS-TV; New York; *George Hankoff*, Screen Gems Inc., New York
Canadian, Jan. 15, Shelly Films, Toronto	Film — "Supersonic Sentinal" produced by Avro Aircraft Ltd., Toronto Report of Subcommittee on Laboratory Standards of the Canadian Section, by *Rodger Ross*, Canadian Broadcasting Corp., Toronto "TV Studio Practice" by *Harold Wright*, Canadian Broadcasting Corp., Toronto
Dallas–Fort Worth, Jan. 15, American Telephone & Telegraph Exchange Bldg., Dallas	Tour of AT&T facilities. Description of equipment by *Walter Allen*, AT&T
Hollywood Section, January 20, ABC Studio, Hollywood	"New Horizons for Motion Pictures and Television" by *Norwood L. Simmons*, Eastman Kodak Co., Hollywood Film — "Our Islands of Hawaii," presented by *Ed McGlone*, produced by Cate & McGlone for Hollywood Airlines, Hollywood Film — "The TV Workshop," presented for *Warren G. Smith*, J. Walter Thompson Co., New York
San Francisco, Feb. 10, Ampex Corp., Redwood City, Calif.	"Recording Color Video on Tape" by *Joe Roizen*, Ampex Corp., Redwood City, Calif. "Editing and Splicing of Videotape" by *Glenn Pew*, Ampex Corp., Redwood City, Calif.
Hollywood, Feb. 11, Stage 6, Motion Picture Center Studios, Hollywood	Demonstration of Ampex Videotape Cruiser by *Hal Mohr* and *Robert Day*, Ampex Corp., Redwood City, Calif.
Hollywood, Feb. 16, Douglas Aircraft Co., DC-8 Jet Assembly Plant, Long Beach	Tour of the Douglas DC-8 Jet Production Plant
Atlanta, Feb. 17, WAGA-TV Studios, Atlanta	"Production Use of Ampex Videotape Recorder" by *Bob Marshal*, WAGA-TV, Atlanta "Problems of Taping a Weekly Show" by *Skip Thomas*, Peachtree Production Assoc., Atlanta
New York, Feb. 18, Carnegie International Endowment Center, New York City	"A Program-By-Program Billing System for Pay-TV" by *Kenneth A. Simons*, Jerrold Electronics Corp., Philadelphia, Pa.
Rochester, Feb. 19, Dryden Theatre, Eastman House, Rochester	"Stereophonic Sound" by *W. W. Dean*, General Electric Co., Syracuse, N. Y.

current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 39, Dec., 1958
Tomorrow's Photographic Assignments (p. 684)
Automatic Electronic Focusing (p. 686)
Cinematography—Vital Tool in Rocket Motors Production (p. 688) *J. J. Lipper*
Animated Film Techniques, Pt. V. (p. 694)
Single-System Magnetic Sound—New Trend in TV News Film Photography (p. 696)
New Lenses for the 16mm Professional (p. 698) *F. Foster*

vol. 40, Jan. 1959
Animated Film Techniques Part VI (p. 38)
Importance of Variable Shutter (p. 40) *J. Forbes*
Exposure Meter for High-Speed Photography (p. 43)
Camerette Double-System 16/35mm Sound Camera (p. 45) *J. Henry*
Wide Screen in Sixteen (p. 48) *E. Wildi*

vol. 40, Feb. 1959
Ultra-Widescreen Movies with One Camera, One Projector (p. 104)
"The Hanging Tree" (p. 112)
Animated Film Techniques Pt. 7 (p. 114)
Assignment "Frostbite" (p. 117)
"Visual Squeeze"—New Technique for Commercials (p. 118) *A. Boyars*
Multiple Reel Film Editing Aid (p. 120) *F. Foster*

British Kinematography vol. 33, Nov. 1958
Automatic Devices in Cinematography (p. 123) *F. N. G. Leevers*

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Benzyl Alcohol	PH4.181–1954
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Boric Acid, Photo Granular	Z38.8.103–1949
Citric Acid, U. S. P. Granular	Z38.8.102–1949
Formaldehyde, N. F. Solution 37%	Z38.8.152–1949
Graphol (Metol)	PH4.125–1956
Hydroquinone	PH4.126–1955
Potassium Alum, U. S. P. Granular	Z38.8.150–1949
Potassium Bichromate, Photo Granular	PH4.300–1958
Potassium Bromide, U. S. P. Granular	PH4.200–1955
Potassium Ferricyanide, Fine Granular	PH4.302–1958
Potassium Metabisulfite, Granular	PH4.277–1957
Potassium Persulfate	Z38.8.181–1949
Sodium Acetate, Anhydrous Granular	PH4.176–1958
Sodium Bisulfite, Photo Powdered	Z38.8.276–1949
Sodium Bromide, U. S. P. Granular	PH4.207–1954
Sodium Carbonate, Monohydrate	PH4.227–1954
Sodium Hydroxide, N. F. Pellets	PH4.225–1956
Sodium Metaborate, Octahydrate	PH4.231–1954
Sodium Sulfate, Anhydrous	Z38.8.175–1949
Sodium Sulfite, Anhydrous Photo	PH4.275–1952
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Sodium Thiosulphate, Rice Crystals	PH4.251–1953

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Printing Motion-Picture Films Immersed in a Liquid. Part III. Evaluation of Liquids. *D. A. Deluvichu, J. D. Clifford, W. R. Weller* (for complete paper, see *Jour. SMPTE, 67:* 678–686, Oct. 1958)

Electronics vol. 32, Jan. 16, 1959

Transistorizing 16-mm TV Remote Film Camera (p. 58) *E. M. Tink*

International Projectionist vol. 33, Dec. 1958

Handling and Projection of 16-mm Sound Motion-Picture Film (p. 5) *R. A. Mitchell*

Color Temperature: What Is It? (p. 10) *W. W. Lozier*

vol. 34, Jan. 1959

New Insights into the Carbon Arc (p. 5) *R. A. Mitchell*

Ampex Mag-Optical Converter for Theatre Sound Systems (p. 8)

Kino-Technik vol. 13, Jan. 1959

Verstärkerketten und Pegeldiagramme der Film- und Fernseh-Tontechnik (p. 2) *P. P. Süther*

Verbesserte Magnetton-Bänder auf Polyesterbasis (p. 8) *A. Kastle*

Fortschritte in der Herstellung von Hör- und Sprechköpfen (p. 11) *W. Dziekan*

Grundlagen für Planung und Bau moderner Fernsehstudios (F1) *P. P. Süther*

Einsatz des Fernsehens in der Spielfilm-Produktion (F6) *E. v G.*

RCA Review vol. 29, Dec. 1958

On the Quality of Color-Television Images and the Perception of Color Detail (p. 495) *O. H. Schade* (also *Jour. SMPTE, 67:* 801–819, Dec. 1958)

Drive Factor and Gamma of Conventional Kinescope Guns (p. 564) *R. D. Gold* and *J. W. Schwartz*

Automatic Control of Video Tape Equipment at NBC, Burbank (p. 642) *R. W. Byloff*

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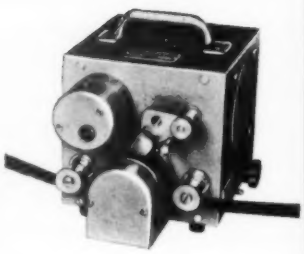

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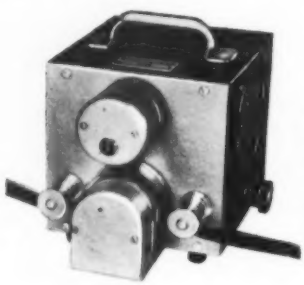

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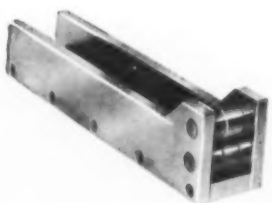

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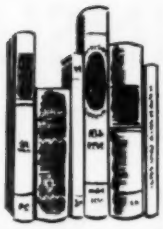

books reviewed

Photosensitors

By W. Summer. Published (1958) by the MacMillan Company, New York. XVI + 585pp. illus. diagrams + 90 pp. references and index. 5½ by 8½-in. Price $21.00.

The book is titled by the generic term, photosensitors, which the author has coined to cover any type of photoelectric element. It deals with the elementary characterization of various photoelectric devices and discusses a large number of industrial applications.

The introductory chapters describe the action and characteristics of photosensitors and will be most helpful to those wishing to familiarize themselves in this device field for the first time. The treatment provides engineers and technicians with basic device fundamentals for applications engineering. Device physics is appropriately discussed only in elementary terms. An elementary background in associated optics is also provided in four chapters.

Some 20 chapters are devoted to the detailing of principles and numerous applications of photosensitors in industry ranging from protective devices to automatic door openers. One is struck by the exceedingly large number of applications which are uniquely assembled in some detail for ready reference. Designers should find *Photosensitors* a valuable guide which charts the present state of the art and provides the background and inspiration on which new controls may be developed.

The bibliography is monumental. A total of 1960 literature references are listed, ranging from the year 1635 to 1952. Six hundred and eighty-seven United States, British, French and German patents are listed in the photoelectric device and applications field. The bibliography and patent sections make this book of great value for both technical and patent reference.—*R. W. Sears*, Bell Telephone Laboratories, Murray Hill, N.J.

Practical Electroacoustics

By Michael Rettinger. Published (1955) by Chemical Publishing Co., 212 Fifth Ave., New York, 271 pp. Illus. Graphs. 5½ by 8½ in. Price $10.00.

(*Edit. Note: Through no fault of the present reviewer, this book has far too long awaited attention in the* Journal.)

This little book is of particular interest to those whose specialty is sound recording or the pickup of music and speech for broadcast. The text is easy to read and it is not intended to be mathematical. The

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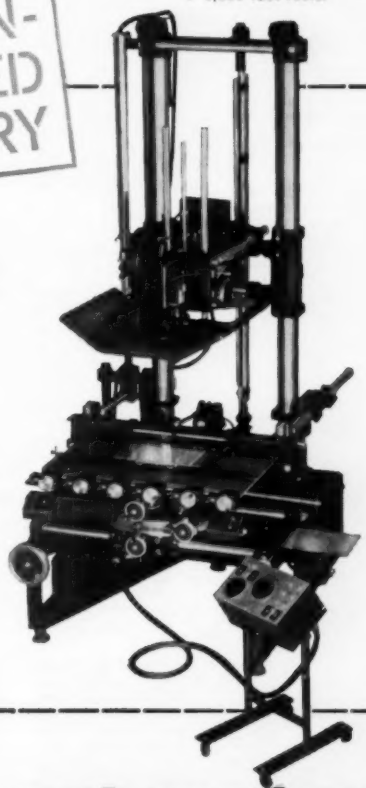

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author's experiences color the book and are especially valuable in controversial areas, such as, for example, microphone placement. The author states, "The purpose of this book is to present engineering information on electroacoustics, covering both basic principles and practical applications."

The sections on microphones, loudspeakers and constant resistance crossover networks are clear and cover items of equipment commonly used in broadcast and recording studios and control rooms. This reviewer found the chapter on public address systems interesting because of the several good examples cited.

The chapter on architectural acoustics would hardly meet wide-spread acceptance by acousticians. Very few acoustical consultants would put much faith in "dynamic symmetry" as a factor in acoustical design. Convex splays for broadcast and motion studios are no longer in vogue either in the USA or in Europe.

The chapter on magnetic recording is long and informative and contains in it interesting practical data. Because the book was published in 1955, some of this material is already dated. The chapters on magnetic structures and vibrations did not thoroughly satisfy the reviewer. The magnetic structures chapter seems suited to students learning practical magnetics while the chapter on vibrations seemed too abbreviated to help the recording or radio engineer. Nevertheless, the information is accurate and easy to follow.

Recording and broadcast engineers as well as those working with public-address systems and home music reproduction should find this book particularly helpful.—*Leo L. Beranek*, Bolt Beranek and Newman Inc., Cambridge 38, Mass.

Sensitometry in Practice

By Keith M. Hornsby. Published (1958) by Henry Greenwood and Co., 24 Wellington St., London W.C.2. Price 19s 6d plus postage 10d if ordered from publisher. Distributed in the United States at $4.75 by American Photographic Book Publishing Co., 33 W. 60 St., New York 23.

This book is a fairly complete, practical and up-to-date treatise on sensitometry. It presents not only the basic principles but also the practical procedures for carrying out sensitometric investigations and practicing sensitometric control.

The fundamental concepts and definitions of sensitometry are given with a touch of historical background and numerous references to practical photographic situations. The elements of sensitometric testing are presented in separate chapters on exposure, processing, densitometry, preparation of characteristic curves and evaluations of characteristic curves.

The basic essentials of a sensitometer are listed as a light source of constant intensity, a light modulating device and a holder for the sensitive material under tests. A shutter and filter holders are mentioned as "refinements." The incandescent electric lamp is said to be universally used as a sensitometric light source. The truth of this statement could be questioned because the electronic flash source should be recognized as a sensitometric light source since it is used in the Mark VI Sensitometer of Edgerton, Germeshausen and Grier, Inc. Time-scale and intensity-scale modulating systems, shutters and filters are discussed. Two sensitometers which are commercially available in England are mentioned. These are the Eastman IIb Sensitometer and the Eastman High Intensity Sensitometer, Model 6. The Model 6 Sensitometer is described, and it is evidently the same instrument as the Kodak Pathe Type 6 Sensitometer. For those who would rather make a simple, less expensive sensitometer, Mr. Hornsby tells how such an instrument can be made, and he gives practical suggestions about its construction and adjustment.

For the processing of sensitometric exposures, Mr. Hornsby claims that satisfactory results can be obtained without the installation of special sensitometric processing machines, which he implies are practical only for large laboratories such as the research laboratories of photographic manufacturers. Developing methods suggested are the vacuum flask method, brush development and roll film tank development. Although simple processing methods are suggested, the necessity for good control of temperature and agitation

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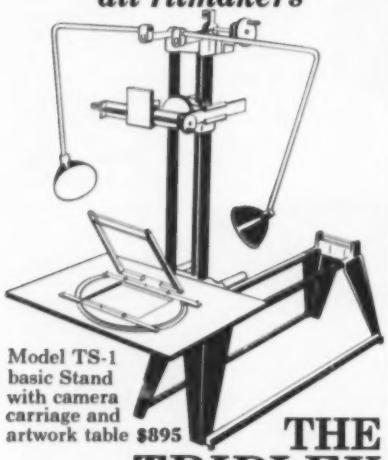

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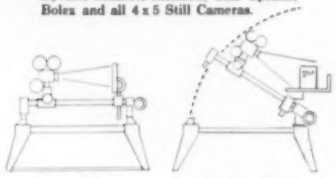

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is stressed. Again, practical suggestions for achieving this are given.

The chapter on density measurement and densitometers gives a good description of specular, diffuse and doubly diffuse density and their relationship to the effective density of a photographic image in contact printing and enlarging. Visual and photoelectric densitometers are discussed and several commercial densitometers are described.

The author goes into considerable detail on the preparation of the characteristic curve, because it is the commonest operation in sensitometry and is the source of the majority of sensitometric data. Graph paper, plotting templates, step identification and the relationship between exposing wedge densities and log E calibration are factors that are included. Even the drawing of a smooth curve and the detection of haphazard errors in plotted points are discussed.

Under the heading of "Evaluating the Characteristic Curve," Mr. Hornsby writes not only about the principal properties of a photographic material such as fog, contrast and speed, but he also devotes space to characteristic curve shape changes and distortions. Various speed criteria are well described. The Hurter & Driffield system, the Scheiner and DIN criteria, the Weston system and the gradient criteria are included. The derivation of the 0.3G speed system, now the basis for ASA and BSI speeds and exposure indexes, is covered adequately and objectively.

The chapter on positive materials is about the special problems associated with the sensitometry of photographic papers. Reflection densitometry systems and some commercially available reflection densitometers are described. The properties of the paper characteristic curves which are of value in determining the significant properties of a paper are given as the maximum usable density, the minimum usable gradient and the exposure range between these two points. The section on matching the negative and paper contains the statement, "It is a sad reflection on public discrimination that in the D. and P. industry (presumably the Developing and Printing industry) where exposure and subject variations are great, it is becoming standard practice to use only one grade of paper in semiautomatic printers without, apparently, displeasing the majority of customers."

Since the accurate determination of absolute spectral sensitivity and contrast characteristics of photographic materials is outside the scope of normal sensitometry according to Mr. Hornsby, his chapter on spectral sensitivity deals primarily with the qualitative evaluation of spectral sensitivities obtained with simple instruments such as the spectrograph, and with color filters.

The sensitometry of multilayer color materials is covered in the longest chapter in the book. The problem in the exposure, processing and densitometry of color materials for sensitometric tests is clearly explained and adequately covered for a book of this kind. Although Mr. Hornsby agrees that analytical color densities cannot be evaluated as easily as integral densities, he says that an understanding of the principles of analytical color densitometry is desirable if the limitations of integral densitometry are to be appreciated. He therefore includes an explanation of analytical density in this chapter in addition to the section on integral density. Pseudo-analytical densitometry, which consists of integral densitometry of single-dye scales obtained by red, green, or blue light exposure, is offered as a simple method that can be used in some testing situations. The limitations of pseudo-analytical densitometry are noted, however.

The chapter entitled, "Product Testing" tells how sensitometric tests can be used to evaluate the performance of a new sensitive material or processing solution. Time-gamma curves, time-temperature curves and tone reproduction curves are relationships that are derived by sensitometric tests. The estimation of the true effects of treatments such as hypersensitization, latensification, intensification and reduction can only be carried out sensitometrically, says Mr. Hornsby.

A chapter on sensitometric control opens with the statement: "By far the greatest application of sensitometric methods by users of photographic materials is in the control of processing." This chapter tells how to choose a developer which will provide the easiest control, how to maintain constant development and how to choose and store a film for control test use. Methods of recording and evaluating control test data are discussed. The control of drift by adjusting the replenishment rate is thoroughly covered.

The sensitometry of miscellaneous light-sensitive materials is taken up in the next chapter. The special sensitometric procedures necessary in the sensitometry of reversal materials, variable contrast materials and ultraviolet sensitive materials are described. The over-riding principle is always the same, says Mr. Hornsby, namely, the material is given a series of accurately controlled exposures under conditions which are as close as possible to those used in practice; it is then processed under standard conditions, the densities measured and a curve plotted from which numerical expressions of the material's characteristics can be obtained.

The final chapter in this practical book is on approximate methods and is aimed at those in the photographic business who cannot justify the financial expenditures for the equipment necessary for obtaining accurate sensitometric results. Mr. Hornsby says that very valuable information can be obtained from the use of quite simple improvised equipment, provided the limitations of its use are recognized, and provided also that the user's basic knowledge of sensitometry is sound. This book certainly gives the reader every opportunity to acquire a basic knowledge of sensitometry. It is evident that the author's intention is to make sensitometry available and understandable to the commercial photographer, the scientific photographer, the photofinisher and other workers in the field of photography who may have considered sensitometry as a highly technical subject of interest only to the photographic manufacturer and research worker. Mr. Hornsby has attained this objective.—*Fred Eisen*, Kodak Research Laboratories, Eastman Kodak Co., Rochester 4, N.Y.

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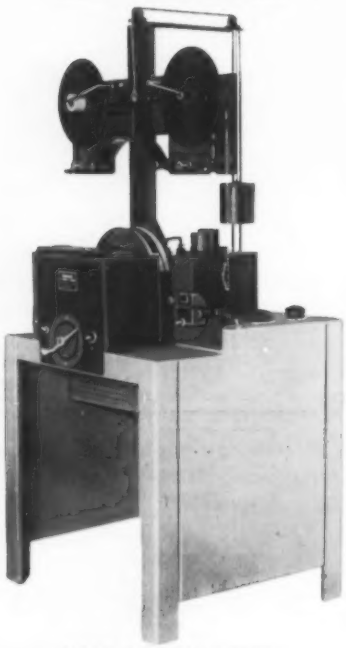

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Photo Chemistry in Black-and-White and Color Photography

By George T. Eaton. Published (1957) by Eastman Kodak Co., Rochester 4, N.Y. 124 pp. 8¼ in. by 5¾ in. Illus. Price $1.25.

An excellent little book written for photographers and technicians who have had very little formal training in chemistry, physics or photographic theory. All phases of photographic processing in black-and-white and color, negative-positive and reversal are discussed briefly and simply to provide a good beginning to the study of this field.

A somewhat better discussion of the washing process appears here than in many of the more technical books on photography, giving this phase more of the relative importance that it deserves. The explanation of pH and its importance in photography is so clearly made that no photographer should have difficulty in understanding it. The book is well illustrated and nicely lithographed.—*H. L. Baumbach*, Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.

Wir Filmen Mit 8mm

By Heinrich Freytag. Published (1958) by Fotokino Verlag-Halle, Halle (Saale) C 2, Muhlweg 19, Germany. 140 pp. Illus. 4¾-in. by 6¾ in. Price DM 5.10

Beginners in the field of home movies who read German will find this small book a useful introduction to the field. It is sized to slip handily into one's pocket. The book briefly presents all the information needed to make a start with the 8mm camera, covering the fields of camera technique, home movie production, editing, titling, and projection. Exposure is outlined for black-and-white, Kodachrome, and Agfacolor films, but no film processing is mentioned. The 140 pages are well illustrated and, while the book is aimed at users of 8mm film, the remarks generally apply also to 16mm film.—*Robert S. Barrows*, Kodak Research Laboratories, Eastman Kodak Co., Rochester 4, N.Y.

Journals Available/Wanted

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Available

Issues beginning in 1953 available on a nominal basis. Write: Mitchell M. Badler, 1711 Davidson Ave., Bronx 53, N. Y.

Complete set of Transactions, except Nos. 6 and 9, and all Journals published to date, including indexes. All in good condition. Price $500. Also extra copies of Transactions Nos. 2, 3, 4, 5, 8, 21, 31, 32. W. W. Hennessy, RFD #2, Pound Ridge, N. Y.

Complete set of Journals from May 1937 to June 1954, including special volumes and membership directories, excellent condition; also Mar., May 1934 and July 1935 issues. Write: Harry R. Lubcke, 2443 Creston Way, Hollywood 28, Calif. HO 9-3266.

Jan.-Dec. 1950; Jan., Feb., Apr.-Dec. 1951; Jan.–Mar. 1952. Also available are vols. 6 and 7 of The Television Society (British) covering the period Jan. 1950 through Sept. 1955. Write: Andrew N. McClellan, 65 Hillside Drive, Toronto 6, Ont., Canada.

Dec. 1946, Feb.–Dec. 1947, 1948–1955 complete. All copies in perfect condition; for sale as entire lot only. Write: Joseph W. MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio.

Jan. 1947 to Dec. 1957 complete and in perfect condition. For sale only as a set. Write: Charles J. Marshall, 2816 Royalston Ave., Kettering 19, Ohio.

Complete set of Journals Jan. 1949 to Dec. 1958. Perfect condition. What offers? Write: J. G. Jackson, 210 Kingsway South, Port Alberni, B.C., Canada.

All Journals June 1940 to Oct. 1958, except Aug. 1943, Jan., May, Nov. 1946, Dec. 1953. Write: David Waddell, 95 North St., Stoneham 80, Mass.

Feb. 1937; May–Dec. 1938; 1939–1943 complete; 1944 complete except for May; 1945 complete except for Jan.; 1946 complete; 1947 complete except for Apr., May, June; 1948 complete except for June; 1949–1950 complete; Jan., Feb., Mar. 1951; 1952 complete; Feb., Mar. 1953. Also Edison Home Kinetoscope in operating condition, with 4 reels of original film and 2 glass slides. Bill Straley, 123 Arroya Vista Dr., San Antonio 1, Texas.

Jan., Mar. 1958; Feb.–Apr., June–Sept., Dec. 1947; Jan., July–Oct., Dec. 1946; Feb. 1937; June 1936; Index 1936–45. Fine condition; $1 each. James G. Barrick, 1278 West 103 St., N. W., Cleveland 2, Ohio.

Wanted

Jan. 1938. E. Raymond Arn, Film Associates, Inc., 4600 S. Dixie Ave., Dayton 9, Ohio.

High-Speed Photography, Vols. 2 & 3. Morton Sultanoff, Terminal Ballistics Laboratory, Aberdeen Proving Ground, Md.

High-Speed Photography, Vols. 1, 2 & 3. John H. Waddell, Fairchild Camera & Instrument Co., 5 Aerial Way, Syosset, N. Y.

Jan. 1938, Jan. 1949. Dept. of Cinema, Univ. of Southern Calif., University Park, Los Angeles 7. Att: Herbert E. Farmer.

Transactions No. 1, 1916 ($5 offered); No. 6, 1918 ($10 offered); No. 7, 1918 ($10 offered). James G. Barrick, 1278 West 103 St., N.W., Cleveland 2, Ohio.

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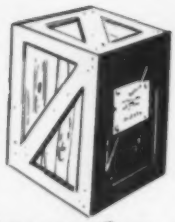


new products

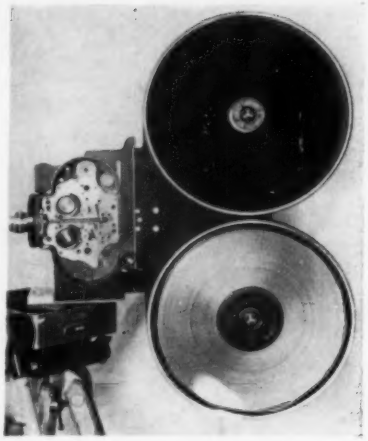
(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

An opto-electronic telescope that uses a supersensitive television camera has been developed by the Air Force and is in operation in the Weaver Observatory at Wittenberg College, Springfield, Ohio, where it has been used to take pictures of the moon. The system is based on a pickup tube developed by Westinghouse Electric Corp. Electronic Tube Div., Dayton, Ohio. It is said to be three to four times more sensitive to white light than tubes previously used for telescope photography. Its sensitivity to longer wavelengths in the spectrum from yellow to red makes possible remarkable daylight pictures of the moon and planets. A composite photograph of the full moon, made up of more than 200 separate pictures, shows the rays of the crater Tycho and other awesome details which are indistinguishable in other photographs.

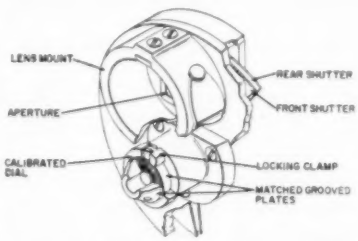
A 16mm Fastax high-speed camera, Model WF-3T, designed to supplement but not replace the standard 8mm and 16mm 4-sided prism cameras, has been announced by Wollensak Optical Co., Dept. FA-3, 850 Hudson Ave., Rochester 21, N.Y. The new camera has a high-index glass 2-sided prism shutter plus a new drive mechanism. The continuous rotating 2-sided prism is synchronized with film movement to take 150 to 6000 pictures/sec. The camera uses 100-ft daylight loading spools and is designed especially for studies of short duration. The new camera will be on display in Booth 45 at the Miami Beach Convention.

The Traid Model 805 Fototracer, a 16mm camera which holds 1200 ft of film and may be used for filming any events up to 50-min duration has been announced by Traid Corp., 17136 Ventura Blvd., Encino, Calif. Designed specifically for rocket engine testing, it is also suited for other applications requiring large film capacities. It is a ruggedized lightweight, intermittent-movement design and operates at 16, 24, 32 and 64 frames/sec from a governor-controlled heavy-duty motor. A fail-safe device automatically stops the camera if the film breaks. Extra-large sprockets provide more teeth to engage the film perforations and provide greater pulling power on the roll of film.



A new Autex, Model VI-2, has been announced by Flight Research Inc., Box 1-F, Richmond 1, Va. The new automatic exposure control device is similar in principle to earlier models, but has been redesigned for increased ruggedness, reliability and convenience of operation. The control circuits are completely transistorized, employ the latest printed circuit techniques, and are potted in epoxy resin for the sake of reliability. The control box measures 1⅝ by 4 by 9¾ in. Batteries in the control box make the device independent of external power. Adapters are available for mounting the control head to any camera. The flexible drive cable used to couple the control head to the iris ring of the lens permits connection to any size of lens without interference between exposure control and lens focus adjustment.

This system is the subject of a paper and demonstration scheduled for May 5 at the Society's Convention at Miami Beach.



A variable shutter for the Flight Research 35mm Model IV-C Multidata Camera, designed primarily to meet the need for a convenient method of changing exposure with long focal length lenses has been developed by Flight Research Inc., Box 1-F, Richmond, Va. Designed to minimize inertia, the unit consists of two rotary shutters mounted on concentric shafts with the blades held together by matched grooved plates. The shutter opening can be changed from 0° to 130° in 2.5° gradations by means of a calibrated knob on the camera face. The knob locks in place to insure stability of the shutters in set position.

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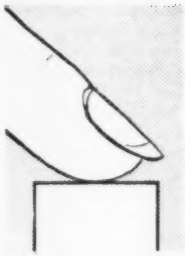

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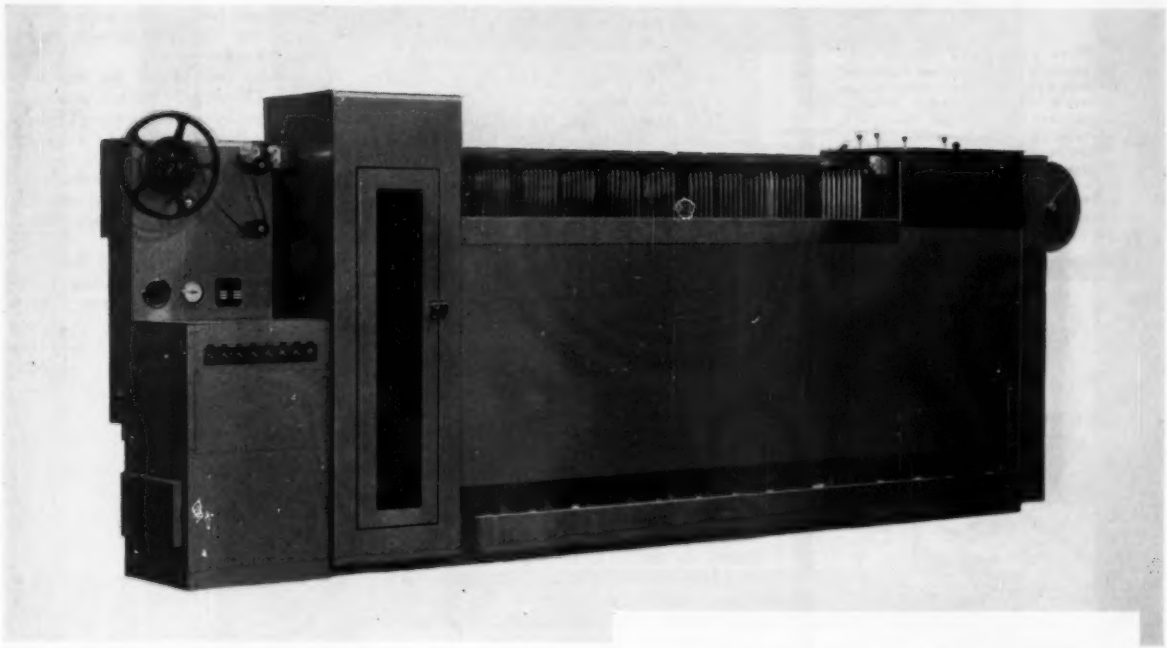

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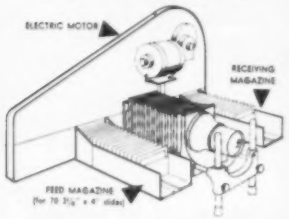

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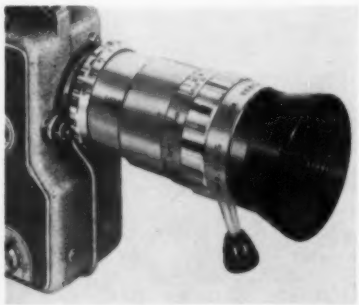
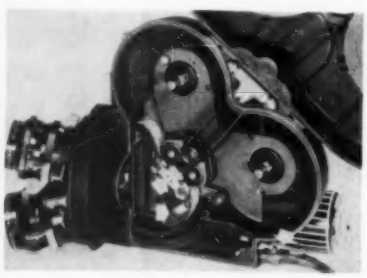
A series of lenses made of "non-browning" glass for use with industrial TV cameras in observation of radioactive areas has been announced by Wollensak Optical Co., Rochester 21, N.Y. Glass used in the lenses is reported to withstand one million Roentgen of gamma radiation (cobalt 60) at the rate of 240 Roentgens/min with less than 5% browning for the wavelength region 4500–7000 A. The lenses are described in detail in a paper scheduled for presentation at the SMPTE Convention in Miami, May 3–8.



The Pan-Cinor 10 to 30 mm *f*/2.8 Varifocal Zoom-lens for the Camex Reflex 8 has been announced by Karl Heitz, Inc., 480 Lexington Ave., New York 17. Designed for continuous through-the-lens viewing and focusing while filming, a lever moves a group of internal lens elements to change the focal length from 10mm to 30mm to achieve simulated dolly effects. For sharpness of focus the lens is set at 30mm. As the focal length is decreased, the increasing depth-of-field automatically keeps the lens in focus. The lens, lens shade and filter together are priced at $379.00. The lens alone is priced at $199.00.



An automatic buckle switch, a sprocket roller guide assembly and a motor cable safety catch for the Arriflex 16 camera will be introduced by Kling Photo Corp., 257 Fourth Ave., New York 10, at the SMPTE International Equipment Exhibit held in connection with the Convention, May 4–8, in Miami Beach. The automatic buckle switch, located in the film path near the lower loop, shuts off the camera motor at the end of each film, or whenever the film jams. The switch is reset automatically when the film is placed through the sprocket rollers. The automatic cutoff is especially useful when the camera is used in a sound blimp. The motor cable catch lock automatically engages and locks the power supply cord to the camera plug-in receptacle to prevent accidental disconnection.

The premiere of the Studio Varotal Zoom Lens, developed jointly by Taylor, Taylor & Hobson Ltd., Stoughton St., Leicester, Eng., and the British Broadcasting Co., took place on December 25, 1958, when the lens was used by B.B.C. in broadcasting the Queen's speech. (The lens is described in a paper by Gordon Henry Cook, "Television zoom lenses," in the January 1959 *Journal*.) The lens was designed to perform the same function within the studio that an earlier lens, called the Outside Broadcast Varotal, was designed to accomplish outside the studio, that is, to make gradual changes between panoramic views and magnified close-ups without losing any quality of definition.

The camera controls for the lens used during the Queen's Broadcast were specially developed by the Engineering Division of B.B.C. The lens is operated by a capstan on the right-hand side of the camera. This rotates for focusing and slides backwards and forwards for zooming, enabling the cameraman to perform the whole operation with one hand.

Representative in the United States for Taylor, Taylor & Hobson is Albion Optical Co., 1410 N. Van Ness Ave., Hollywood 28.

The Bolsey-8, a miniature 8mm camera "smaller than a king-size pack of cigarettes," has been announced by Bolsey-Delmonico, 42–24 Orchard St., Long Island City, N.Y. Measuring 3½ by 1¼ in., the camera weighs 12 oz when fully loaded with 25 ft of single 8mm film in the magazine. Designed for practically fool-proof operation, one full winding of the key provides from 8 ft to 10 ft at 16 frames/sec, or for single-frame exposures for still pictures by rotating the exposure button from M to S. Variable shutter speeds allow exposure times ranging from 1/50 sec to 1/600 sec.

The inventor of the tiny instrument, and President of Bolsey Research and Development Corp., 11 W. 57 St., New York 19, is Jacques Bolsey, an early member of the Society who, at one time, resided in Switzerland and acted as the Society's European correspondent.

The Perfectone Model EP6A Portable Magnetic Recorder is a recent development of Produits Perfectone S.A., Bienne (Bern), Switzerland, designed for professional recording on ¼-in. magnetic tape at a speed of 7½ in./sec where no power

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supply is available. Transistorized circuits permit the overall dimensions to be kept to 12 by 6 by 2¼ in. The recorder can be used in conjunction with a blimped Camerette camera with Pan-Cinor zoom lens.

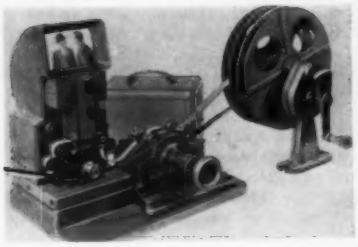
A synchronizing signal, generated by the camera motor, is recorded on the magnetic tape. In transfer to perforated magnetic film, this signal is amplified to drive the motor of the re-recorder, thus holding the soundtrack in synchronism with the picture. The 12-v camera motor embodies a transistorized type of feedback speed control and a device for generating the 100-cycle synchronizing signal. The motor and its attachment fit on the Camerette camera inside the standard blimp.

The recorder itself is driven by 12 elements of storage batteries contained inside the recorder; they will run for 17 hr continuously, and can be recharged up to 400 times. Power consumption is 4 w Data provided by the Swiss Post Office authorities and by the Commission Supérieure Technique of France give the following characteristics: signal-to-noise ratio −55 db; harmonic distortion at 100% modulation better than 2.5%; peak-to-peak speed variation not exceeding 0.15%; wow/rms value better than 0.08%; flutter/rms value better than 0.06%.

On replay, the full width of the tape can be scanned, but since the synchronizing signals are in push-pull, they cancel out in reproduction. For transfer to perforated magnetic or optical film, the push-pull signals are fed into a synchronous amplifier where they are first amplified, then through a flywheel circuit converted to single-phase a-c and finally into 3-phase 220 v. The output of the power amplifier is 150 w, adequate for driving the motor of an RCA PM66 re-recording channel. For re-recorders with higher power requirements, a synchronous amplifier with a total output of 500 w, with 1000-w starting peak, would be used.

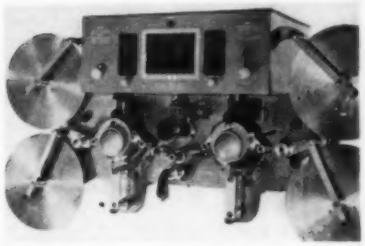
The Perfectone equipment, which will be on display at Booth 19 in the Equipment Exhibit at the 85th SMPTE Convention in Miami Beach, is represented in the U.S. by Benjamin Berg Co., 1410 N. Van Ness Ave., Hollywood 28.

The Magniola line of 16mm double magnetic sound editors has been announced by S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19. Features include 3 by 4-in. picture, built-in cue marker, frame and footage counters, 2-gang synchronizer with magnetic soundhead and amplifier and speaker unit and automatic adjustment for shrunken or unshrunken film stock. It is priced at $450.00. The Deluxe model, designed for single-system editing with



magnetic soundtrack, has two magnetic heads, one for single system and both together for double-system sound. This model is priced at $520.00.

The firm has also announced a Junior Tripod featuring professional grooved legs for rigidity, frontal star knob threading and curved aluminum support locks. It is priced at $145.00.



The Editola Film Editing Machine is manufactured in England by the Photographic Electrical Co., Ltd., 71 Dean St., London W1. Picture and sound are reproduced in proximity, in order to give the effect of auditorium viewing. Virtual image size of the picture is 5 by 3½ in. Either optical or magnetic tracks can be reproduced. Features of this equipment include separate controls for picture light and sound, retractable magnetic head to save wear while optical track is being run, desynchronizing clutch to enable the picture to be run independently of the sound, footage counter with single-picture indicator, and constant-speed electric motor. The machine may be stopped within a frame. Either combined picture and sound or separate picture and sound may be run, also, with slight alteration, 17.5mm soundtrack. Accessibility to both film apertures is claimed as another feature permitting greater accuracy in making or erasing indication marks on the film.

A portable, plastic-encased pump and filter unit has been announced by Oscar Fisher Co., Newburgh, N.Y. The unit is said to remove all particulate insoluble matter from 5 microns up and including some from 5 microns down. The solution leaves the filter at the rate of 10 gal/min. The filter is rated at 125-psi maximum operating pressure at 120 F. The pump is rated at 50 lb. pressure and 12 gal/min. The unit operates on 110-v or 220-v 60-c

A newly styled and lower-priced 16mm sound motion-picture projector, the Film-O-Sound 384A, has been announced by Bell & Howell, 7100 McCormick Rd., Chicago 45. The new projector has a custom-built 5 by 7-in. oval speaker permanently built into the front of the projector. Features include simplified operation with no clutch

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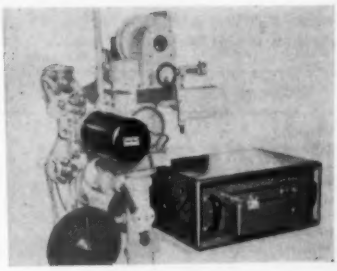

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or reverse, and a new rotary dial control for lamp and blower. It is priced at $459.95.

Bell & Howell has also announced the 390TA Perpetua, a three-lens turret model 8mm electric eye camera priced at $129.95. The system does not require manual setting and is designed to compensate automatically for indoor or outdoor color film.

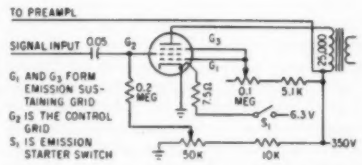
The Elite 8, an 8mm sound projector, of Norwegian manufacture, which provides for recording a magnetic sound stripe on the film, has been announced by Tandberg of America Inc., 10 E. 52 St., New York 22. The projector operates at two speeds, 16 and 24 frames/sec. It has a newly designed high-intensity, low-voltage lamp and uses an $f/1.5$ lens. The recorder has a built-in amplifier, 6-in. loudspeaker and high-fidelity magnetic soundhead. Provision is also made for connecting the amplifier output to an external loudspeaker and high-fidelity magnetic soundhead. Provision is also made for connecting the amplifier output to an external loudspeaker or sound system. The projector is priced at $398.00

The MDC Model 100-1 Film Transport, featuring pin location of the film to within ± 0.0005 in. longitudinal and transverse accuracy, has been announced by Mast Development Co., 2212 E. 12 St., Davenport, Ia. Features include two speeds and single-frame operation in forward or reverse directions. It is announced as built primarily to replace the standard head of the Model C Recordak Film Reader but is designed to be adapted to other precision projection applications.

A prototype of a compatible stereophonic sound system was demonstrated by Motorola Inc., 4545 W. Augusta Blvd., Chicago 51, at Home Furnishings Show held at the Merchandise Mart, Chicago, during January. Viewers watched a 15-minute segment of a taped show and heard the corresponding sound first monaurally and then binaurally with the sound coming from two separate speaker cabinets, with the difference in sound being "immediately evident," the announcement stated. FM multiplexing techniques are used in constructing the sound system.

Quality-control equipment installed in the Magnetic Products Div. of Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn., is expected to reduce greatly the number of field rejections of video tape. The equipment includes a video-tape quality control machine specially developed by CBS-TV, and also two Ampex Videotape recorders, with space for four more. Three electronics engineers and six assistants provide around-the-clock quality-control service.

A method of magnetic writing with an electron beam is described by the inventor, Ludwig Mayer, in an article in the October 1958 issue of the Journal of Applied Physics (pp. 1454–1456). The method is based on a thermal magnetic recording method called Curie-point writing. When a suitable pre-magnetized magnetic film is set up as an anode in a cathode-ray tube-like device, a focused electron beam heats the film in the areas where electrons impinged. If the dissipation of the electron beam is high enough to raise the temperature above the Curie point or any suitable transition temperature, the areas of the magnetic film heated by the electronic beam become non-magnetic. Traces of reversed magnetization have been recorded on MnBi films. Practical application of this method, with writing speeds between 10^6 and 10^8 bits/sec is possible, the article states, with increased speed possible if finer-grained magnetic films can be developed.



A cold cathode tube, consisting essentially of a thin layer of magnesium oxide deposited on a nickel sleeve, has been announced jointly by the Army Signal Corps Research and Development Laboratory and Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N.J. The cold cathode, based upon an electron emission phenomenon discovered at ASCRDL during a study on the field-enhanced secondary emission from MgO, is believed to be adaptable to almost all types of electron tubes, including TV screens, military communications equipment and industrial uses. Use of a pre-production cold cathode as an audio output amplifier has been demonstrated (see circuit above). The new tube is distinguished by a blue, luminescent glow (as opposed to the red glow of the hot cathode) and uses less than one-tenth the power of a standard tube. Laboratory life tests on the cold cathode indicate indefinite life. One cold cathode in a test socket emitted for over 14,000 hours with no apparent deterioration.

Theater-type television in a circular or semicircular sports arena with a seating capacity of 20,000 is a project of Giantview Television Network, 901 Livernois, Ferndale 20, Mich. Four lightweight motion-picture screens are suspended over the center ring of the arena in a hollow box for-

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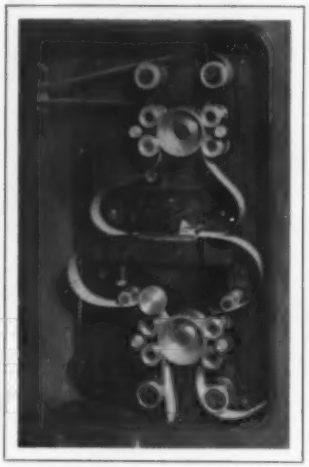

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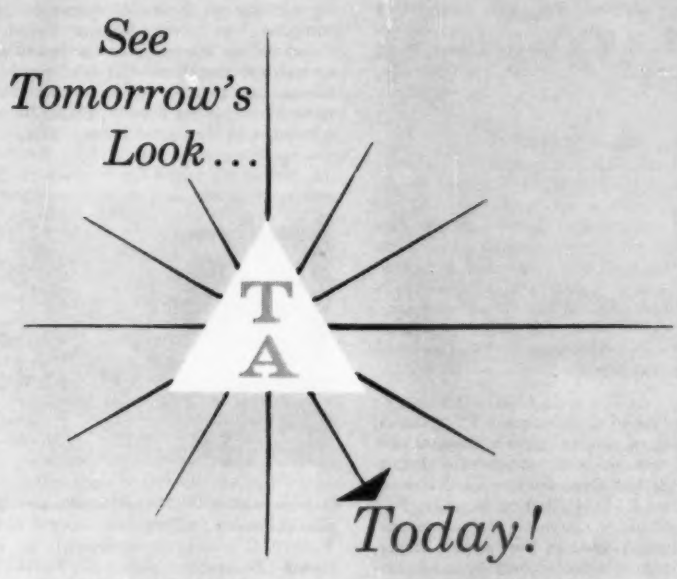

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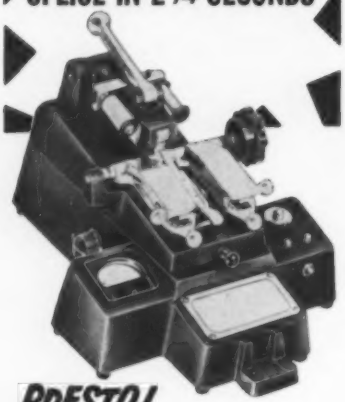

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mation. The corners of the frames of the screens are tied together with light twine. Each screen is served by a mobile television projector placed in a separate quadrant of the arena. The four-screen technique has recently been used in the Providence, R. I., Auditorium; the Ohio State University St. John Arena; and the Toledo Sports Arena.

Symphony Week in Detroit was opened by a closed-circuit TV presentation of a backstage recording session presented simultaneously with a live performance of the Detroit Symphony orchestra onstage. Two motion-picture screens mounted to the left and the right of the orchestra shell showed the recording engineers and directors. A third camera was focused on the conductor. The presentation was arranged by Giantview Television Network, 901 Livernois, Ferndale 20, Mich.

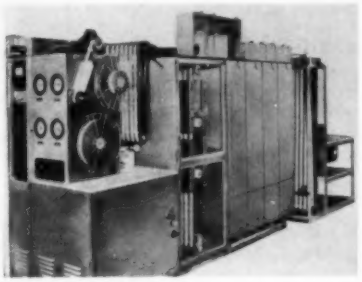
A new line of closed-circuit TV systems, consisting of vidicon camera, monitor and control unit, has been announced by Industrial Products Div., International Tel. & Tel. Corp., 15191 Bledsoe St., San Fernando, Calif. An electronic light compensator is incorporated in the camera. Accessories include remote controls, explosion-proof and weather-proof housings, distribution amplifiers and multiple camera switches. The firm announced that its application engineers will adapt the systems to specific requirements.

A color processing laboratory has been opened in Panama City, Panama, bringing to 13 the number of foreign laboratories opened by Eastman Kodak for processing Kodachrome film. The new laboratory will serve northern and western countries of South America, and parts of Central America and the West Indies.

Other Kodak color processing laboratories outside the United States are located in Mexico City; Toronto; Harrow, England; Sevran, France; Stuttgart, Germany; Lausanne, Switzerland; Milan, Italy; Johannesburg, South Africa; Bombay, India; Melbourne, Australia; Manila, Philippine Islands, and Honolulu, Hawaii.

A symposium on cinefluorography was held at the University of Rochester Strong Memorial Hospital, Rochester, N. Y., Nov. 14–15, 1958. Among scientists who discussed various aspects of the technique of making x-ray motion pictures were George M. Corney of Kodak Research Laboratories; Frederick M. O'Brien, Jr., of Kodak's Apparatus and Optical Div.; Rudolf Kingslake, Director of Optical Design; and Gordon A. Chambers of the Motion Picture Film Dept. Among subjects discussed were films and developers, recording cameras, lenses and equipment for film printing and duplicating.

Purchase of Times Facsimile Corp., a subsidiary of the New York Times Co., by Litton Industries of Beverly Hills, Calif., has been announced. The name will not be changed. W. Preston Corderman, a Vice-President of Litton, will become President of the Times Facsimile division. Austin G. Cooley, Executive Vice-President of Times Facsimile will continue in that capacity. No personnel changes are planned. The Times Facsimile service dates back to 1935. In addition to facsimile equipment, the company has produced sonar recorders, chronometers, telemetering equipment and special instruments utilizing high-precision timing instruments. A system for transmitting x-ray films over telephone lines is scheduled for early production.



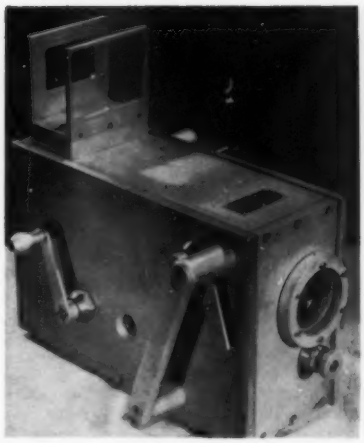
A new model 16/35mm black-and-white film processor, an improved version of the FA-100M, has been announced by Hi-Speed Equipment Inc., 73 Pond St., Waltham 54, Mass. Operated in daylight, the developer is reported to have a speed of 65 ft/min negative and 135 ft/min positive, with guaranteed gamma curves. Processing is done by open sprays. The impingement drier has been designed to provide full view of the drying operation. The equipment is of modular design and is 12 ft long, 2½ ft wide and 6 ft high. Price varies according to equipment but approximate price for a machine with four processing stations is $36,000. The unit is supplied with a minimum of three processing stations, or it can be supplied with as many as may be required.

Splicing kit Model A 4809, made especially for perforated programming paper, aluminum, Mylar or other perforated tapes, has been announced by Unicorn Engineering Corp., 1040 North McCadden Place, Hollywood 38. Basically, the splicer consists of a small metal block with a row of small pins which fit into the feed holes of either the standard five- or eight-hole tapes. The tape's two broken ends are aligned on the metal block by the feed hole pins, pushed down and smoothed out, and a short piece of adhesive material with punched holes is placed over the joined ends. Overlapping splices may be cemented. The kit is priced at $10.00.

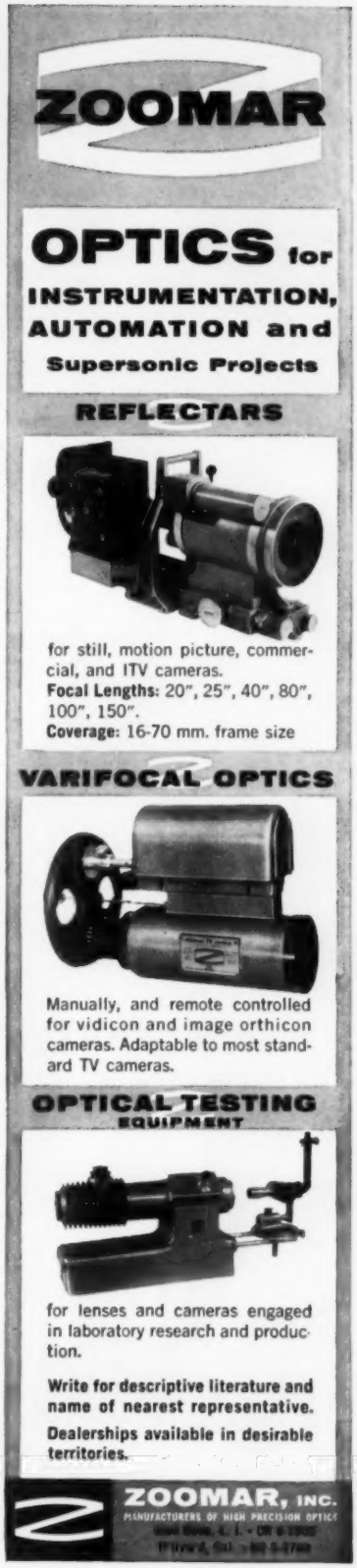
Planotype is a new plastic letter made by Planoscope Corp. and distributed by Camera Equipment Co., Inc., 315 West 43 St., New York 36, for the photographic and motion-picture industries. It is used for motion-picture titling, TV slides, and in artwork for slide films. The letters come on an aluminum sheet, 12 by 15-in., and they range in size from $\frac{3}{8}$ to $1\frac{1}{2}$ in. They are available in a number of type designs. Normal temperature changes and amounts of moisture do not affect the plastic. The letters have beveled edges to keep them fitted to the artwork surface, yet they can be lifted and stored and re-used repeatedly. Planotype is now available as an opaque letter in black, white and red; as a transparency, in blue, red, green and yellow.

The Craig Pro 16mm film viewer, a product of Kalart Co., Plainville, Conn., is designed for heavy-duty use. Features include a 4 by 6-in. viewing screen and optical system to minimize eye fatigue, screen illumination of 20 ft-c, and coated optics which include a 3-element *f*/2.8 projection lens, condenser lens and 4-sided rotating prism shutter. Light source is a 75-w projection lamp. The price is $89.50.

Rubber Properties for Stage and Screen is a brief, illustrated article in *Rubber Developments, Vol. 11,* no. 4, Winter, 1958. It is available at no charge by writing to: Natural Rubber Bureau, 1631 K St., N. W., Washington 6, D. C.



An underwater housing designed for use with the Kodak K-100 Camera has been announced by Camera Equipment Co., 315 W. 43 St., New York 36. The housing accommodates a 10mm *f*/1.8 fixed-focus Angenieux lens. The iris can be controlled under water. An open sight viewfinder shows 10-mm field of view. Dimensions of the housing are $12\frac{1}{4}$ by $9\frac{1}{4}$ by $12\frac{1}{2}$ in. Camera and housing together weigh 30 lb. Designed to withstand water pressure at a depth of 75 ft an accessory pressure valve is available to permit use at depths down to 175 ft.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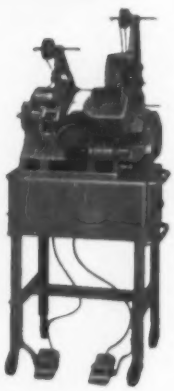

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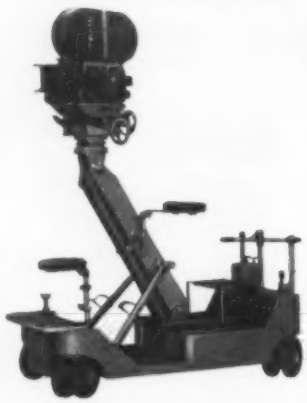

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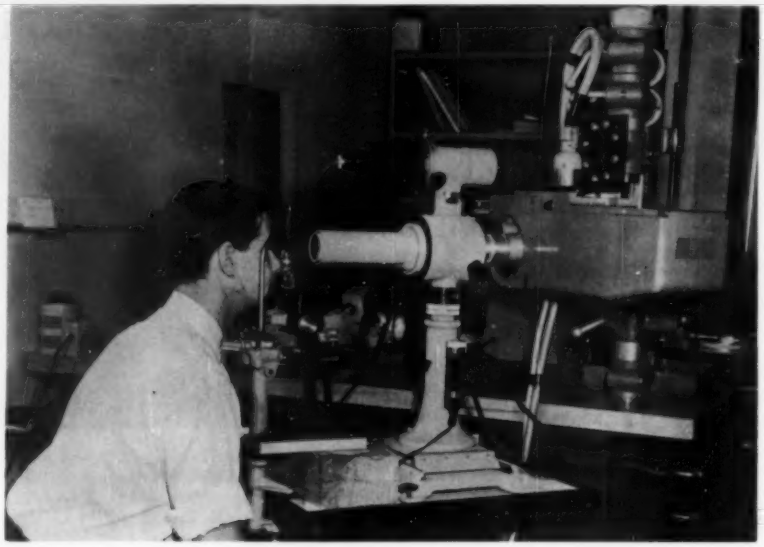


A field-sequential television system developed by CBS Laboratories, Stamford, Conn., for use in medical research, was demonstrated at the First Annual Conference on Television in Medical Education at the National Institutes of Health, Bethesda, Md. A color motion picture was shown of the back of a living, sighted human eye. The TV system, combined with specially developed equipment, is expected to make possible advanced diagnostic techniques in studying ailments of the eye and the brain. The camera used in the system is more sensitive to light than the human eye, making possible detailed studies that could not otherwise be undertaken because of danger of tissue damage resulting from bright lights.

The BE6 Band Elimination Filter has been announced by Allison Laboratories Inc., 14185 Skyline Drive, La Puente, Calif. This is a continuously variable filter covering the range from 20 c to 20,000 c in passive network form. It has a direct reading dial and is tuned with one knob. It can be used to eliminate one frequency in measuring circuits where hum is interfering with normal measurements, or where the resonant response of an accelerometer prevents analysis of other frequencies present, or where it is desired to measure the distortion and hum present in an amplifier while eliminating the fundamental test frequency. It is priced at $385.00.

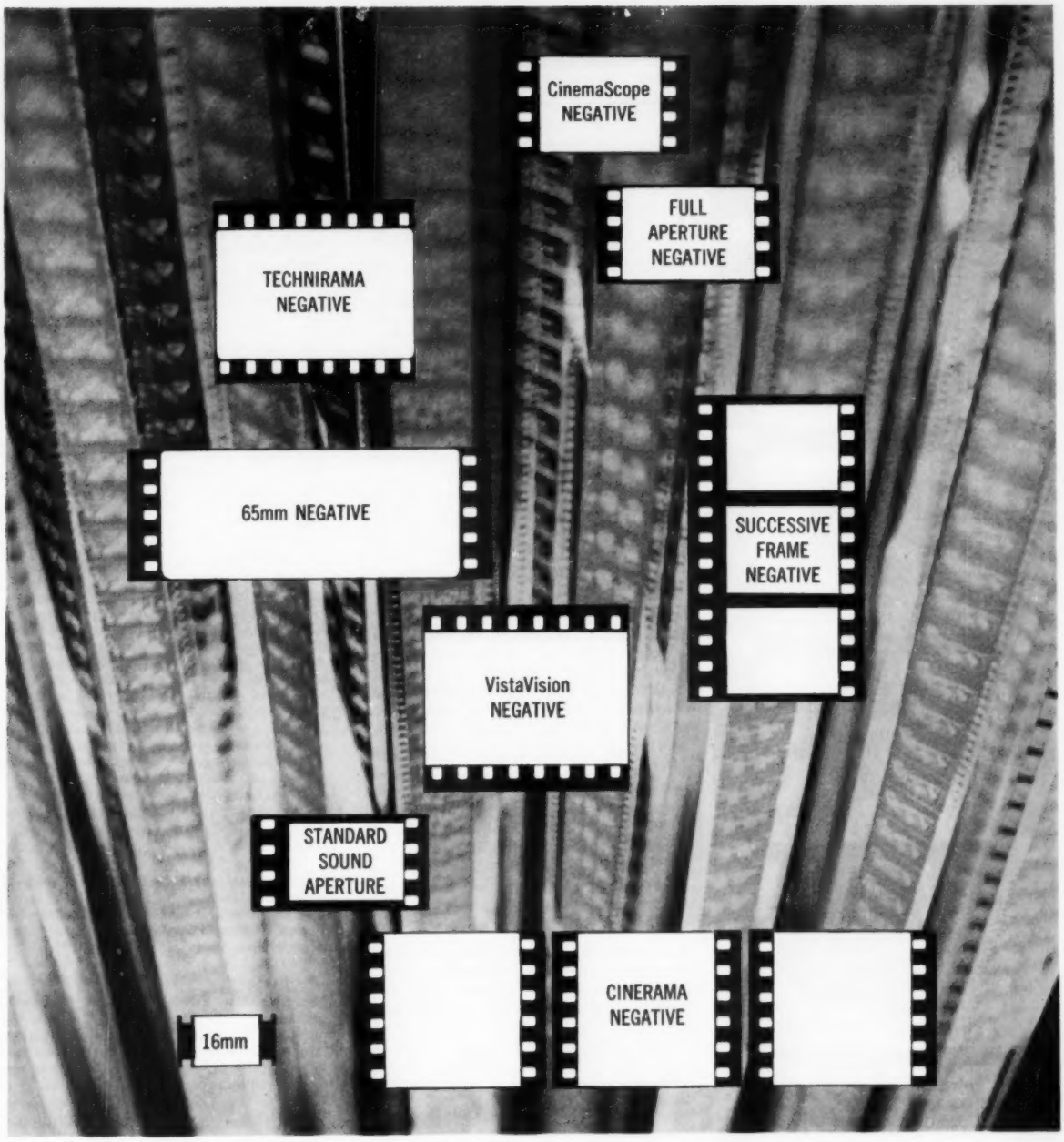
A lease plan for television studio equipment has been announced by the Technical Products Dept., General Electric Co., Electronics Park, Syracuse, N. Y. Under this plan studios may rent equipment on a monthly basis over a five-year period. Minimum value of equipment covered under the monthly lease is $5000.00. As new equipment is made available it may be substituted for the equipment leased originally on an option-to-replace arrangement. Monthly rates are to be adjusted accordingly.

Color Television, a technical training manual published by Radio Corp. of America, is intended for use in planning operating and maintaining color TV broadcasting stations. Eighth in a series of technical books, the manual first reviews the basic principles of color and then covers such areas as equipment, planning a color TV system, integration of color and monochrome equipment, transmitter adjustment, color tape recorder and microwave relay and other subjects of theoretical and practical interest. The book is priced at $10.00. In addition to being made publicly available, it will be used as a textbook for RCA's technical training programs.

A ground weather radar system that enables TV stations to broadcast "pictures" of approaching storms as far away as 150 miles has been developed by Radio Corp. of America. The system's transmitter sends a high-power, rapidly pulsed signal to a disk-shaped antenna, which rotates 360° at 15 rpm within its protective housing, capped by a Plexiglas radome. When the signal encounters a storm or other weather target, some of the transmitted energy is reflected back to the system's receiver. The electronic circuit measures the length of time for the signal to make the round trip, and the data are pictorially displayed on the indicator screen in contour form, showing the storm core and areas of heaviest rainfall.

Through the use of a standard RCA studio vidicon film camera, the radar scope presentation of a storm may be transmitted to the TV station's viewers, with the radar "picture" superimposed on a map of the area for orientation.

Lens formula data problems may be solved by a system of graphs, charts and



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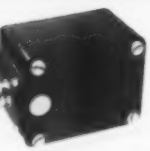

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dial-calculators called Keemag, a trademark for these aids developed by Joseph D. Brubaker, Photographic Design Engineer, 949 Sherman Ave., Evanston, Ill. Keemag (magnification is the key) is described in a folder as a system of pre-computed lens formula data of universal application, based upon ten factors affecting the practical use of photographic lenses at working distances less than 20 times their focal length, and at corresponding magnifications (image/object size ratios) of 1/20th to 20X.

Solid optical glass filters are described in a recent folder of The Ednalite Optical Co., Inc., 200 North Water St., Peekskill, N. Y. Besides describing precision characteristics and photographic advantages, the folder illustrates some of the 55 operations and inspections performed for the color glass filters.

National Camera Repair School has issued a 56-page booklet, *Open Door to Success*, which describes the training offered by NCRS, Box 174DS, Englewood, Colo. It is replete with testimonials and has outlines of all the lesson texts.

Robert W. King and **Leonard H. Reed** have been added to the staff of Traid Corp., 17136 Ventura Blvd., Encino, Calif. Both men are specialists in photographic instrumentation systems. Mr. Reed has accepted the post of Application and Service Engineer. Mr. King will specialize in the development of new airborne instrumentation systems.

A "how-to-do-it" folder on tape splicing is offered by Minnesota Mining and Mfg. Co., Dept. M8-340, St. Paul 6, Minn. A series of drawings shows how to cut tape, butt the edges together and what happens if the wrong angle is used. Tips on editing and storing are included.

Planning and costs of closed-circuit TV programs are covered in a 12-page booklet, issued by Giantview Television Network, 901 Livernois, Ferndale 20, Mich.

Communications Productions Inc. has opened offices at 1352 Beacon St., Brookline, Mass. The firm offers facilities for production and presentation of closed-circuit broadcasts.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Motion-Picture Cameraman, Technician. Active member SMPTE now employed at medium market TV station photographing, processing and editing news and commercial 16mm footage. Owner of two motion-picture cameras, lenses, tripods, lights, etc. Desires connection with producer of industrial, scientific, educational, religious or travel films. Available on 30 days notice. Résumé on request. Frank E. Sherry, 915 Mockingbird Lane, Tyler, Texas. Tel: LYric 3-4337.

Electronic Engineer. Television Major, B.S.E.E., age 28, vet, 4 yrs military electronics and radar and 1 yr TV experience, specializing in broadcasting and recording. Knowledge of color and microwave systems. Competent in magnetic, photographic and kinescope recording. Thesis written on magnetic video tape recorders. Desires position in motion-picture sound or TV studio engineering. Civilian or military projects. Foreign or domestic assignments. Fluent in German. Excellent references. Available June 5, 1959. Andis Lepnis, 5401 So. Ellis Ave., Chicago 15, Ill.

Chemical Engineer. B.Ch.E. Clarkson College of Technology, Potsdam, N.Y., Sept. 1958. Desire position in production or pilot plant. Write: Robert H. Cleveland, 732 Parsons Rd., Ridgewood, N.J.

Motion-Picture Engineer. 25 yrs responsible positions in large organizations. Expert in all technical phases motion-picture laboratory color or B&W. 2 yrs as technical director and sales engineer for representative of well-known motion-picture equipment. Motion-picture consultant to U.S. Govt. agencies in Washington. Will accept responsible position supervising laboratory operations in management, quality control, install new laboratories, etc., or as technical sales representative for motion-picture equipment. Will consider most sections of U.S. or certain overseas assignments. Excellent knowledge of three languages. U.S. citizen. Write: E.C.C., First Floor, 219–47 74th Ave., Bayside 64, L.I., N.Y.

Film Specialist. 3 yrs as animation cameraman; 2 yrs on optical camera; 5 yrs film editor and cameraman on commercials and industrials; produced films for Signal Corps at Astoria, also writer-director for A.F.R.S.; B.A. in Cinema, UCLA; member IATSE, Local 659. Familiar with every job concerned with production of motion pictures on professional level. Presently employed but desire change. Age 32, married. Good bet for ad agency, teaching or production. Have knowledge, will travel. Write: E. E. F., P.O. Box 19783, Los Angeles 19.

Electrical Engineer. Long experience design and maintenance all types electrical equipment in motion-picture studios, exchanges and laboratories. Many yrs chief electrician Paramount Pictures Corp., New York. Will accept position preferably New York area. Member SMPTE, IAEI. Fred F. Stederoth, 41 Watsessing Ave., Bloomfield, N.J. PIlgrim 3-2699.

Cameraman. Desire position with progressive film-making organization. Have worked with most 16 and 35mm cameras using commercial color and B&W. Experienced in interior location, and set lighting, also editing, A&B roll cutting, sound recording, and process equipment. Free to travel. Resume available. H. LeRoy Mills, P.O. Box 245, Blacksburg, Va. Tel: Prescott 2-8261, Ext. 452.

Cinematographer-Editor. Desire position in educational film unit or commercial film company. Two years experience photographing and editing many educational films covering wide range of subjects. Writing and practical motion-picture laboratory experience. Age 23, married. B.A. degree in Speech and Television. Write Larry D. Filby, Box 70, Iowa City, Iowa.

Producer–Director–Writer — also production-coordinator. Early thirties. Unencumbered. Veteran. A1 health. College education. Multilingual. Best references. Produced, directed and written features, T.V. series, documentaries, industrial and educational shorts on five continents. Can operate still and movie cameras and own some professional equipment. Particularly well versed in foreign co-production problems. Recently returned from three-year stay in Latin America, now trying relocate. Wide personal and business connections throughout world. Have worked for U.N., Governments of U.S.A., U.K., Brazil, Netherlands, France, India, Australia, Ecuador. Fifteen years professional movie writing. Seek contract here or abroad. Write c/o PIDO, P.O. Box 816, Hollywood 28, California.

Motion-Picture Technician. Three yrs military and one yr civilian cinematography. B.S. degree in radio and television. Desire position within motion-picture or television realm. Prefer to locate Southern California area but will consider other locales. Write: Gerald L. Wiley, 136 Cedar Ave., Hershey, Pa.

Motion-Picture Specialist. Formerly with Paramount News and Walt Disney Productions seeks position heading up motion-picture department. 25 yrs world-wide studio and field experience directing and filming news, documentaries, educationals, industrials, commercials, training and report films. Expert on sound recording, lighting, studio operation, design of special equipment, hiring and supervising personnel. Would be interested in a stimulating industrial opportunity with responsibility and potential. Lewis S. Cass, 321 East Palisades Blvd., Palisades Park, N. J. WIndsor 7-1944.

Television and Film Operations and Design Specialist. More than 20 yrs major network service in television, including several yrs in TV development laboratory, equipment desig and construction, live and film operation, supervision of operating sections with special emphasis on film and kinescope recording. Recently Manager of Film and Kinescope Facilities Operations. Charles Townsend, 49 Hillcrest Dr., Dumont, N. J. Dumont 4-8622.

Motion-Picture Career Engineer. Ten yrs in film labs on equipment design, B/M control, procurement, floor plan and chemical layouts, automatic controls, power supply, relay circuits, etc. Familiar color sensitometry, cameras, printers, projectors. Currently working within the industry on product design. Available for non-routine "better"position in line with MIT degree in Engineering Administration. Will consider attractive location anywhere on permanent basis. Write care of Marshall W. Lynn, 49 West 24 St., New York 10.

Positions Available

Photo Engineer. Experienced in motion-picture and still production, high-speed, metric color and black-and-white; able to direct complete production unit including labs, motion-picture and still, writers, photography, editing. Applicants should have education and experience to assume heavy project responsibility.

Laboratory Supervisor—Motion Pictures. Assume complete responsibility for lab operation including developing, printing, quality control, black-and-white and color.

Laboratory Supervisor—Still Lab. Assume complete responsibility, still lab, black-and-white and color. Cameraman, Engineering. High-speed, engineering test films. Experienced Fairchild, Fastax, Traid, Bell & Howell.
Applicants for above positions should be willing to relocate. Write for appointment, including resume, to: P.O. Box 189, Times Square Station, 340 West 42 St., New York 36.

Senior Optical Engineer. Direct development proprietary line of high-speed cameras and other photographic instruments. Must have analytical ability and research or development experience with optical devices or photographic instrumentation; able to plan and carry out projects from inception through prototype stage. Position carries full technical responsibility and should be attractive to qualified applicants with managerial potential. Salary open. Advanced degree desirable. Plant located in pleasant suburban area near San Francisco. Contact George Bingham, Beckman & Whitley, Inc., 973 E. San Carlos Ave., San Carlos, Calif.

Theatre Sound Engineer. Cinefones, Bombay (India), requires theatre sound engineer with good technical qualifications, thoroughly experienced in installation, repair and servicing all types of theatre projection and sound equipment, and with administrative experience. Send complete resume airmail to Cinefones, 3 New Queen's Rd., Bombay 4, India.

Salesman, experienced, excellent opportunity motion-picture equipment and accessories organization. Comprehensive Service Corp., 245 West 55 St., New York 19.

Summer Employment Television Engineer or top-grade technician to operate and maintain professional broadcast-type vidicon closed-circuit television system from May 15 to August 1, 1959. Please furnish references, qualifications and salary requirements. Delaware Steeplechase & Race Assoc., P.O. Box 268, Wilmington, Del.

TV Sales Engineer. Graduate electrical engineer preferred with experience selling airborne and ground TV systems to Army, Navy and Airforce and weapons systems contractors. Age to 40. Salary open. Immediate opportunity. Send resume and salary requirements to: Personnel Manager, General Precision Laboratory, 63 Bedford Ave., Pleasantville, N. Y.

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Meeting Calendar

American Physical Society, Mar. 30–Apr. 1, Hotel Somerset, Boston & MIT, Cambridge, Mass.

Microwave Research Institute, Polytechnic Institute of Brooklyn, Symposium on Millimeter Waves, Mar. 31–Apr. 2, Engineering Societies Bldg., New York.

Inter-Society Color Council, 28th Annual Meeting, Apr. 1, 1959, Statler-Hilton Hotel, New York.

Optical Society of America, Apr. 2–4, Hotel New Yorker, New York

AFOSR, Third Annual Astronautics Symposium, Apr. 6–8, Sheraton-Park Hotel, Washington, D.C.

Armour Research Foundation, 4th Conference on Industrial Instrumentation and Control, Apr. 14, 15, Ill. Inst. of Technology, Chicago.

Biological Photographic Association, Midwestern Sectional Meeting, Apr. 24–26, Univ. of Iowa, Iowa City, Iowa.

American Physical Society, Apr. 30–May 2, Willard & Raleigh Hotels, Washington, D.C.

Electro-Chemical Society, 7th Annual Semiconductor Symposium, May 3–7, Sheraton Hotel, Philadelphia.

85th Semiannual Convention of the SMPTE including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

IRE 7th Region Technical Conference and Trade Show, May 6–8, Univ. of New Mexico, Albuquerque, N.M.

Acoustical Society of America, May 14–16, Ottawa, Ont.

IEE, Transistors and Associated Semiconductor Devices, International Convention, May 21–27, Earls Court, London.

American Rocket Society, June 8–11, San Diego, Calif.

International Conference on Information Processing, June 13–22, Unesco, Paris, France.

International Commission on Illumination, 14th Congress, June 15–24, Brussels, Belgium.

International Symposium on Circuit and Information Theory, June 16–18, Univ. of Calif., Los Angeles.

Engineering Progress Exposition, June 17–20, Hotel Commodore, New York.

American Physical Society, June 18–20, Milwaukee, Wis.

American Society for Testing Materials, Annual Meeting, June 21–26, Chalfont-Haddon Hall, Atlantic City, N.J.

86th Semiannual Convention of the SMPTE including Equipment Exhibit, Oct. 5–9, Statler, New York.

National Electronics Conference, Oct. 12–14, Hotel Sherman, Chicago.

Society of Photographic Scientists and Engineers, Oct. 26–30, Edgewater Beach Hotel, Chicago.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, and Fifth International High-Speed Congress and Equipment Exhibit, Oct. 16–22, 1960, Sheraton-Park Hotel, Washington, D.C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1958 Journal, Part II.

sustaining members

of the Society of Motion Picture and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

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The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee: Byron Roudabush, c/o Byron, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.